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T COM
160A
DS3/DS2/DS1
TRANSMISSION ANALYZER

T-COM Corporation 825 East Middlefield Road Mountain View CA 94043 (415) 964-3415

INSTRUCTION MANUAL

For The

T-COM 160A

DS3/DS2/DS1 TRANSMISSION ANALYZER

With Option 02

160A S/N : 0129
HW version: 2.0
SW version: 1.2

Instruction Manual No.: IM 160A-01
Date isssued : January 1992

BOUT THIS MANUAL ...

you have never used the 160A and you ould like to become thoroughly familiar with e capabilities and operation of this strument, we recommend you spend time ading this manual. In particular, we highly commend you read the first three chapters. om that point, you may want to read the apters of immediate interest. Learning will increased if you set up the instrument earby and try out functions and procedures you go through the material.

o make this manual easier to use, it is ganized into short chapters, each covering a ngle topic. The topics and the associated apters are listed to the right:

Topic	Chapter
160A Capabilities	1
Familiarization with the 160A	2
Getting Started	3
DS3, DS2 and DS1 Monitoring and Performance Analysis	4
DS3 Transmitter	5
Out-of-service Testing	6
RS-232-C Interface Port	7
Options	8
Auxiliary Jacks and Connectors	9
Specifications	10
Calibration	11
Accessories	12
Warranty	13

160A INSTRUCTION MANUAL
TABLE OF CONTENTS

cription Page

160A Capabilities Overview.....1-1
1.1 - Introduction.....1-1
1.2 - Overview of the 160A Basic Capabilities.....1-1
1.3 - Overview of the 160A Optional Capabilities.....1-2
1.4 - Applications Overview....1-3

Familiarization With The 160A 2-1
2.1 - Introduction.....2-1
2.2 - The Front Panel Functions.....2-1
2.3 - Right Side Panel Features 2-11
2.4 - Left Side Panel Features 2-12

Getting Started.....3-1
3.1 - Introduction.....3-1
3.2 - How to Set-Up and Initialize the Instrument ..3-1
3.3 - Description of the Self-Diagnostics Capability 3-2
3.4 - System-Level Keys/ Menus Operation 3-3

DS3/DS2/DS1 Monitoring & Performance Analysis.....4-1
4.1 - Introduction.....4-1
4.2 - Real-Time DS3/DS2/DS1 Transmission Monitoring.4-1
4.3 - How to Select the Proper PCM Input Mode..4-1
4.4 - Performing Real-Time DS3 Transmission Monitoring 4-1
4.5 - Performing Real-Time DS2 Transmission Monitoring 4-5
4.6 - Performing Real-Time DS1 Transmission Monitoring 4-7
4.7 - Summary of Performance Measurement Definitions 4-11
4.8 - In-Service Monitoring Application Information ..4-12

Description Page

5. Using The DS1 Transmit Capabilities.....5-1
5.1 - Introduction 5-1
5.2 - Generating DS3 Test Patterns 5-1
5.3 - Sending X-BIT alarm 5-2
5.4 - Simulating Errors 5-3
5.5 - Thru Mode Operation 5-3
5.6 - DS1 Drop & Insert.....5-4

6. Out-Of-Service Testing 6-1
6.1 - Introduction 6-1
6.2 - Out-Of-Service Testing Principals 6-1
6.3 - Out-Of-Service Testing Capabilities 6-3
6.4 - 160A Set-Up for Out-Of-Service Testing ..6-3
6.5 - General Out-Of-Service Testing Procedures.....6-4
6.6 - Out-Of-Service Testing Applications 6-4

7. Printer Interface Port (Option 02) 7-1
7.1 - Introduction 7-1
7.2 - RS-232-C Interface Capabilities.....7-1
7.3 - Using the RS-232-C Interface Port.....7-6

8. Options
Chapter is in preparation

9. Auxiliary Jacks and Connectors
9.1 - Introduction 9-1
9.2 - DS1 Out Jack (J11).....9-1
9.3 - DS1 In Jack (J13) 9-1
9.4 - Data Link Access (J12)..9-2
9.5 - RS-232-C Port (J14).....9-2

10. Performance Specifications 10-1

11. Field Maintenance And Calibration.....11-1
11.1 - Introduction 11-1
11.2 - Routine Maintenance 11-1
11.3 - Calibration Overview.....11-1
11.4 - Required Equipment.....11-2

Description Page

11.5 - Accessing the Adjustments....11-2
11.6 - Calibration 11-4
11.7 - Final steps 11-6

12. Accessories And Replaceable Parts 12-1

13. Product Warranty....13-1

Tables

3-1 Switch S2 functions
4-1 Measurement definitions, ranges and criteria 4-11
6-1 Commonly used PRBS patterns....6-3
7-1 Self Test Results Messages 7-2
7-2 Sample Activity Report....7-4
7-3 Sample Activity Summary Report 7-5
7-4 Receiver Status Report....7-6
11-1 Calibration Tools & Test Equipment....10-2

Figures

1-1 160A Front Panel 1-1
2-1 160A Front Panel Groups 2-2
2-2 Control & Measurement Section Features 2-3
2-3 DS3 Diagnostics Section Features 2-5
2-4 DS2 Diagnostics Section Features 2-7
2-5 DS1 Diagnostics Section Features 2-8
2-6 DS3 Transmit Section Features 2-10
2-7 Right Side Panel Features 2-11
2-8 Left Side Panel Features.... 2-12
4-1 Minimum Required Test Time . 4-14
5-1 DS1 Drop & Insert
6-1 Straight Away Test Configuration 6-2
6-2 Looped Test Configuration.... 6-2
6-3 DS3 Measurement Points 6-3
6-4 DCS 3/1 Test Configuration.... 6-5
6-5 M13 Mux Test Configuration .. 6-5
7-1 Null Modem Adapter/Cable 7-7
9-1 Auxiliary Jacks & Connectors . 9-1
9-2 J12 Connector Pin Assignment 9-2
9-3 J14 Connector Pin Assignment 9-3
11-1 Top Cover Removal 11-3
11-2 MMC Calibration Points.... 11-4
11-3 XMTR Calibration Points 11-5
11-4 RCVR Calibration Points 11-5

CHAPTER 1
160A CAPABILITIES OVERVIEW

1.1 INTRODUCTION

The 160A is an extremely versatile instrument. It addresses a wide range of test requirements for DS3 based communication systems and transmission. The instrument is used to qualify new DS3 transmission systems and to maintain them over their operational lives.

This chapter familiarizes the reader with the instrument's capabilities. It is divided into three sections:

- Basic capabilities
- Optional capabilities
- Applications overview

1.2 BASIC CAPABILITIES

The 160A consists of

- a DS3 diagnostics receiver
- a DS2 diagnostics receiver
- a DS1 diagnostics receiver and
- a DS3 transmitter
- a powerful measurement data processor

These sub-systems (shown in Figure 1-1) operate

- independently to perform simple tests
- in concert to perform complex tests

Controls and indicators for each subsystem are conveniently arranged in separate sections of the front panel (Figure 1-1).

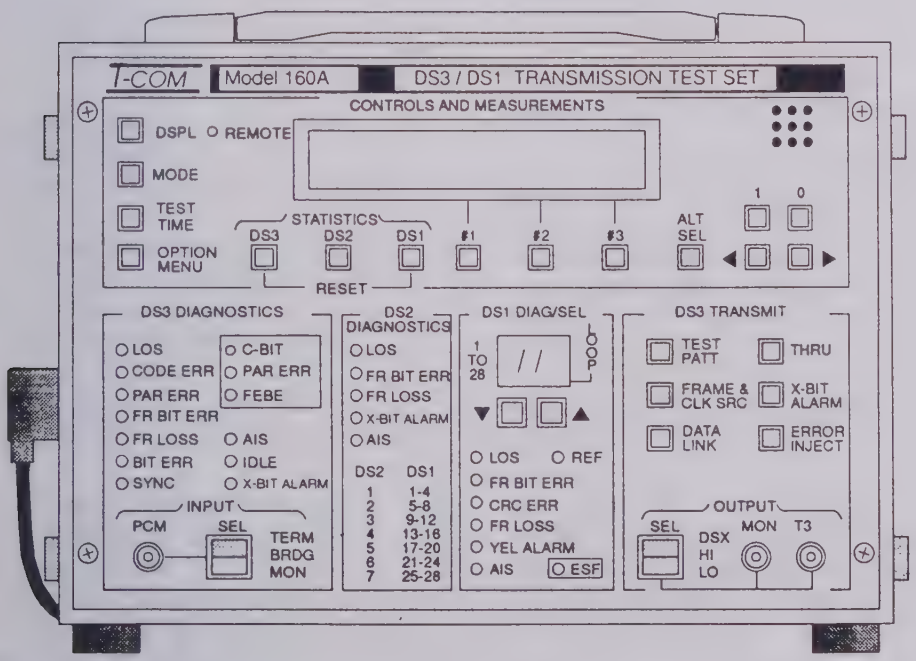


Figure 1-1 160A Front Panel

The DS3 diagnostics receiver accepts a DS3 bit stream and provides the following capabilities:

identifying several out-of-service stress patterns
demultiplexing the received DS3 signal producing an AMI or B8ZS DS1 output signal (available for DS0 channel testing)
accepting three DS3 input levels
-TERM
-BRDG
-MON
automatically identifying the M13 or C-bit parity framing format
demultiplexing the DS3 input bit stream allowing the operator to select:
- one DS2 group among seven available
- one DS1 group among 28 available

The DS2 diagnostics receiver provides impairment and alarm information in real time of the DS2 signal which contains the DS1 digroup selected by the DS1 group selector.

The DS1 diagnostic receiver monitors one of the twenty eight DS1 digroups demultiplexed from the input DS3 signal. It provides the ability to:

- select any one of the 28 DS1 digroups in the input DS3 bit stream
- auto-frame on the DS1 bit stream (SF and ESF)
- identify a C-Bit parity FEAC DS1 line loopback command on the selected DS1
- indicate the presence of a DS1 signal applied to the reference DS1 IN jack

The DS3 transmitter delivers patterns used in out-of-service testing. The transmitter features:

- the ability to multiplex an externally-supplied DS1 bit-stream onto the transmitted DS3 signal
- DS3 BERT testing; it delivers stress test patterns, including framed and unframed PRBS codes, fixed word or a 1 to 8-bit user-defined code
- thru-mode operation
- M13 or C-bit parity framing format
- impairment insertion capability
- DS3 output level settings; DSX, HI and LOW

The measurement data processor collects and processes transmission data from the Diagnostic Receivers Upon user request, processed data is displayed on the display panel in readily usable form. The basic instrument has many measurement capabilities. This includes the ability to:

- accumulate error counts for DS3, DS2 and DS1 simultaneously
- display processed impairment data
- provide impairment history information

1.3 OPTIONAL CAPABILITIES

Capabilities are extended by adding the following options:

Option 01, Remote Control

This option lets you operate the 160A via modem, and control all the settings by entering commands from an intelligent terminal (PC).

Option 02, RS-232-C Printer Interface Port

This option provides an RS-232-C interface port suitable for driving a printer or modem. When a printer is connected to the instrument, a record of the time and date stamped impairment activity is automatically printed out. This option is factory installed.

Option 03, C-BIT Message Transmitter & Analyzer

This capability is implemented by installing a circuit board into an option slot of the 160A. This option permits the 160A to display and transmit various messages carried by the data link in the C-bit parity framing format.

-on Module 80A, Auxiliary DS3 Sources

module mounts to the bottom of the A, adding one inch to its height. It plies six independent time-delayed DS3 als similar to the signal delivered by the A.

> **Note**
> All options can be combined in the instrument.

APPLICATION OVERVIEW

160A helps craft personnel maintain and ubleshoot DS3 transmission systems. It is igned for use in the

central office
communication center
Field use
Customer premise
Controlled Environment Vault (CEV)

0A applications are divided between

out-of-service testing
in-service testing

4.1 Out-of-service Testing

e two main applications areas are

DS3 transmission facility testing
equipment functional check, or acceptance testing

e instrument allows you to simultaneously

- send a variety of test patterns to stress the facility
- obtain a comprehensive performance evaluation

ypically, the DS3 transmitter is used as a gnal source while the DS3, DS2 and DS1 ceivers monitor and analyze the bit stream elivered by the equipment under test. For xample you may test many transmission arameters for M13 multiplexers, 3-3 DACs, nd 3-1 DACs.

1.4.2 In-service Testing

The instrument is particularly well suited to performing non-disruptive transmission performance tests. In this case the instrument is configured to passively monitor a DS3/T3 circuit. The instrument can be

- bridged across the line
- connected in DS1 Drop-&-Insert Mode

Remaining sections in this manual provide detailed information on topics introduced in this chapter.

APTER 2
MILIARIZATION WITH THE 160A

INTRODUCTION

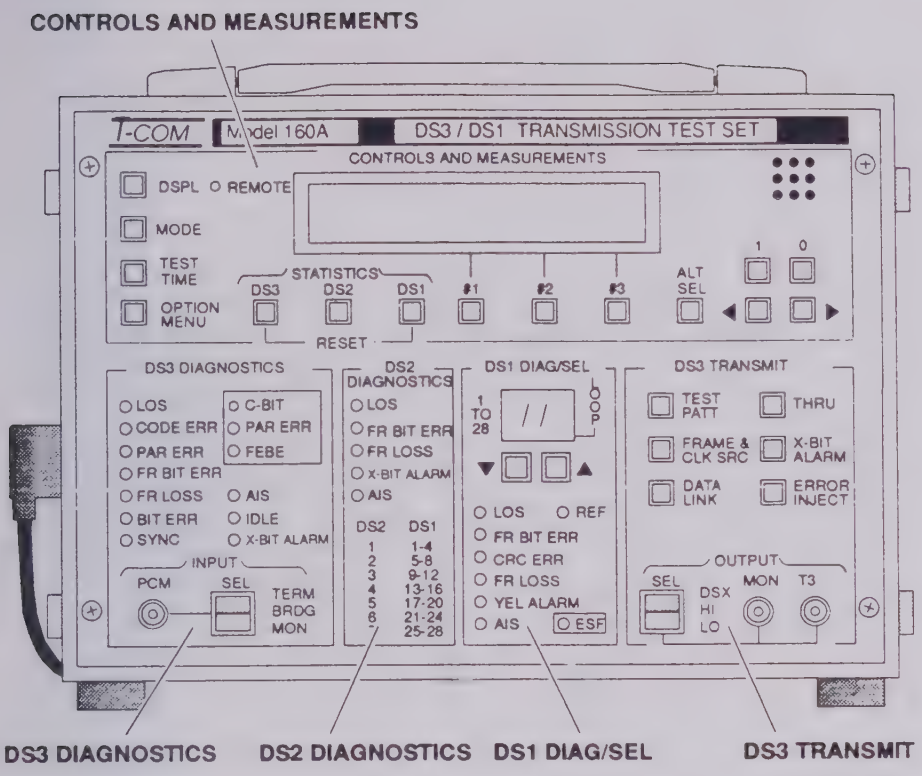
s chapter describes controls, indicators connectors present on the 160A front side panels. The function of each item is cussed, along with a brief introduction to use. Some software based features are o described. Detailed coverage of software ed features are provided in chapters 3 ough 8. You may wish to look over rmation presented in this chapter before erimenting with the various controls on ir unit. This will prepare you to perform ual testing using the 160A.

FRONT PANEL FUNCTIONS

e front panel appears in Figure 2-1. Note t the panel is divided into five functional ups. The text following Figure 2-1 scribes each group referenced in the figure.

Note
The major function keys (buttons) incorporate a light-emitting diode (LED). When a given key is pressed:

- the associated function (identified by labels on the panel) is enabled
- the key flashes the pattern long-on, short-off (FLOSO) to indicate connection with the current VFDT display



igure 2-1 Front Panel Control and Indicator Groups

ONTROLS AND MEASUREMENTS
se this group to set up the test set make uantitative measurements on the PCM signal pplied to the DS3 DIAGNOSTICS receiver ection

S3 DIAGNOSTICS
se this group to diagnose the DS3 input gnal and display impairments and alarm essages in real-time

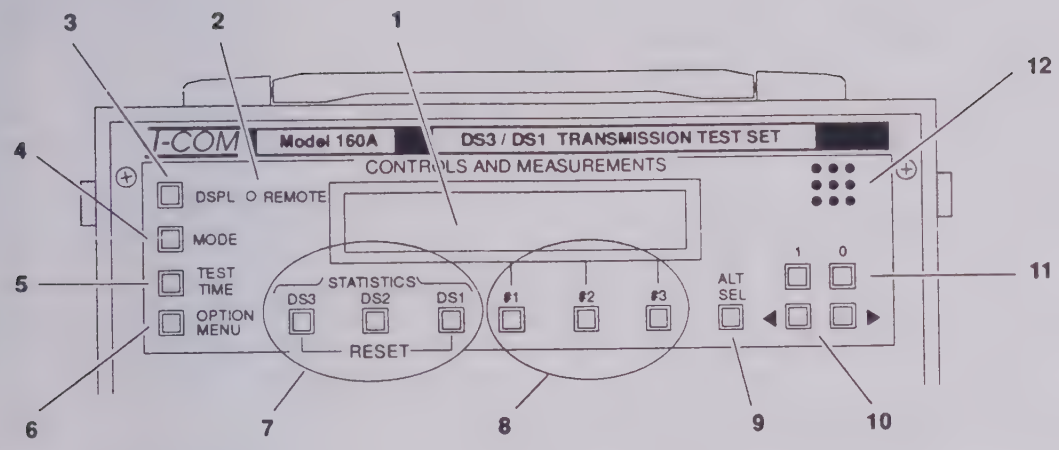
S2 DIAGNOSTICS
se this group to monitor the DS2 group ontaining the DS1 digroup selected by the S1 DIAG/SEL section (see below) and to isplay DS2 impairments and alarm messages n real-time

DS1 DIAG/SEL
Use this group to select and monitor a DS1 digroup within the DS3 input signal and display impairments and alarm messages in real time

DS3 TRANSMIT
Use this group to deliver a family of stress patterns - including

- framed and unframed codes
- 1010, 1100, 2^{15}-1, 2^{20}-1, 2^{23}-1, and all-ones
- 1-bit to 8-bit user-defined code

Also, use it to multiplex an externally-supplied DS1 bit stream onto the DS3 signal. Calibrated impairments can be introduced into the transmitted stream. This transmitter can be combined with the DS3 receiver to provide DS1 drop-and-insert capability.



ure 2-2 **Controls and Measurements Section - Controls and Indicators**

VFDT - The Vacuum Fluorescent Display Tube (VFDT) is a 2-line by 20-character display. The display presents messages and data to the operator.

REMOTE - This LED is lit when the remote control option is active.

DSPL - Use this key to change the VFDT brightness. Default (wakeup) brightness is 75%. Successive depressions of this key cause the brightness to be: 50%, 100% and 75%.

MODE - Press this key to display the mode menu. This allows you to

- initialize and set the clock/calendar
- view the software version number
- display the DIP switch S2 settings (found on the chassis right side; see Figure 2-7).
- select the printer interface parameters
- enter printer commands
- set the beeper on or off

5 **TEST TIME** - Press this key to

- display the elapsed time since the beginning of the test (i.e. since the last reset)
- specify the test duration (as hr:min:sec or continuous)

> **Note**
> If the preset duration is exceeded
>
> - the detected impairment events are no longer processed
> - the impairment event count screens are frozen until the Instrument is reset and a flashing "T" appears on the screen indicating "Timed-out."

6 **OPTION MENU** - This key is used to access the menus associated with certain 160A options. These options will be available in the future.

STATISTICS - Press the desired key to display impairment statistics for the corresponding functional group. Data displayed is that accumulated and/or processed during the test period only. The LEDs in the DS3, DS2 and DS1 keys are steadily lit when an impairment has been detected in the respective section.

DS3 - Press this key to display DS3 impairment statistics.

DS2 - Press this key to display DS2 impairment statistics.

DS1 - Press this key to display DS1 impairment statistics.

RESET (DS3 & DS1) - Press DS3 and DS1 together to

- reset the test time
- reset all impairment counters to zero
- initiate a new test period
- restart the pattern search in the auto-search mode

Softkeys - The function of #1, #2 or #3 keys is screen dependent. Current key functions are identified by the **#1 #2 #3** header displayed immediately above each key. Typically, these keys are used to select functions associated with the current screen. For example in the screen below, the softkeys are used to set the internal clock.

```
TIME :   21:07
         UP   DN   SET
```

(softkey) #1 #2 #3

Softkey #1 increments the digit above the cursor

Softkey #2 decrements the digit above the cursor

Softkey #3 sets the internal clock to the displayed time.

Note: the ◂ and ▸ keys (Figure 2-2, item 10) are used to move the cursor.

9 **ALT SEL** - When the LED in this key is lit, an alternate menu selection can be made by depressing this key.

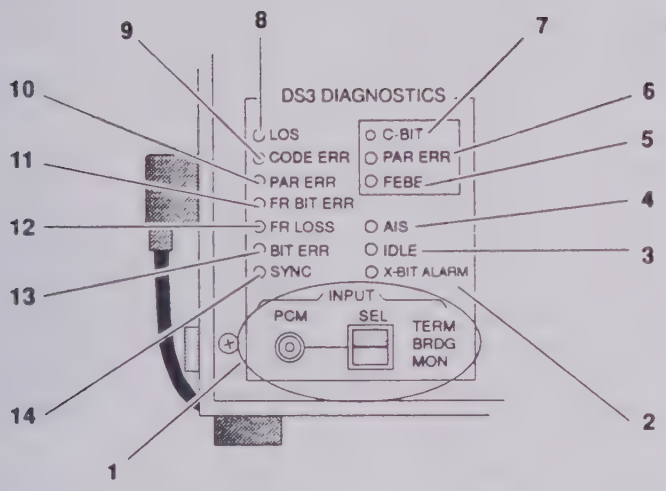
10 ◂ ▸ - These keys are used to move the cursor in the VFDT by field or character. Press

◂ to move left

▸ to move right

11 **1/0** - Use these keys to enter a user-defined code at the selected cursor position (see ◂ and ▸ above). Press 1 or 0 to enter that value at the cursor position within the word.

12 **Beeper** - When active the beeper sounds to indicate that an error has occurred. It may be activated/deactivated via the MODE menu (see Chapter 3 for additional information).



re 2-3 DS3 Diagnostics Controls and Indicators

NPUT PCM - This DS3 PCM input jack accepts a type 440 male plug. The input circuit is compatible with HI and DSX levels. This is true for all settings of the SEL rocker switch (below).

SEL - The three-position rocker switch configures the input circuit to accept signals from the following sources:

TERM - Up position: 75 ohms termination/DSX -3 to HI level

BRDG - Mid-position: 635 ohms termination/DSX -3 to HI level

MON - Down position: 75 ohms monitoring/-20 dBDSX level

2 **X-BIT ALARM** - Lights when a remote alarm is detected. This condition is conveyed by the state of the X-bit being detected for over one second while framing prevails. Selection of alarm for X = 1 or 0 is made using DIP switch S2, position 1.

3 **IDLE** - Denotes that the idle signal was detected for 6 ms or longer. (Active only in C-BIT format)

> **Note**
> Idle pattern consists of the framed sequence 1100....

4 **AIS** - Denotes that the AIS signal was detected for 6 ms or longer.

Note
AIS signal consists of the framed sequence 1010.... Switch S2 (Seen in Figure 2-7) lets you comply with the Bellcore requirement that DS3 C-bits be set to zero by setting S2/3 to OFF.

Bit-related LEDs

FEBE - This LED flashes on for 40 ms when a Far-end block error (FEBE) is detected. It is lit steadily when the FEBE rate exceeds 25 errors/second. Such errors can be reported only when the system is in C Bit parity format (see C-BIT below).

PAR ERR - This LED flashes on for 40 ms when a C-Bit parity error is detected. It is lit steadily when the error rate exceeds 25 errors/second. Such errors can be reported only when the system is in the C Bit parity format (see C-BIT below).

C-BIT - When lit, this LED identifies that the input DS3 signal is in the C Bit parity framing format.

LOS - The loss of signal indicator flashes for 40 ms when the DS3 input signal contains a string of 175 ±25 consecutive zeros (non-B3ZS code). It is lit steadily when the DS3 input signal is absent (no PCM).

CODE ERR - This LED flashes for 40 ms when a B3ZS code violation has occurred. It is lit steadily when code violations are occurring at the rate of 25/second or higher.

Note
A B3ZS code violation may be in the form of

- 3-or-more consecutive zeros, or an
- illegal bipolar violation

10 PAR ERR - The parity error LED flashes for 40 ms when a parity error has been detected. It is lit steadily when the parity error rate exceeds 25/second

11 FR BIT ERR - The frame bit error LED Flashes for 40 ms when a frame bit error has been detected (only F bit errors are detected).

12 FR LOSS - The frame loss LED flashes for 40 ms when a frame loss occurs. This requires either:

- 3 corrupted frame bits within a group of 16 frame bits or
- 3 corrupted M-bit patterns in a row

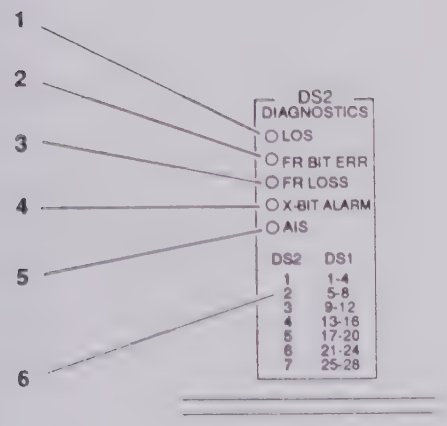
13 BIT ERR - This LED flashes on for 40 ms when a bit error is detected while pattern synchronization prevails. It is lit steadily when the error rate exceeds 25 errors/second.

14 SYNC - This LED has three states. When:

Lit red - the receiver has lost pattern synchronization

Lit green - the receiver is synchronized on the incoming pattern

off (dark) - the receiver has not acquired pattern synchronization since the last reset



ıre 2-4 DS2 Diagnostics Controls and Indicators

LOS - The loss of signal indicator flashes for 40 ms when the DS2 signal in the selected group contains a string of more than 175 ±25 consecutive zeros. It is lit steadily when no DS2 input signal is present in the selected group (no PCM).

FR BIT ERR - The frame bit error LED flashes for 40 ms when a frame bit error was detected in the monitored DS2 group. (Only F bit errors are detected)

FR LOSS - When lit, a frame loss has occurred. This condition requires

- 2 DS2 frame bits to be corrupted within a group of 5 frame bits or
- 2 consecutive M-bit patterns to be corrupted

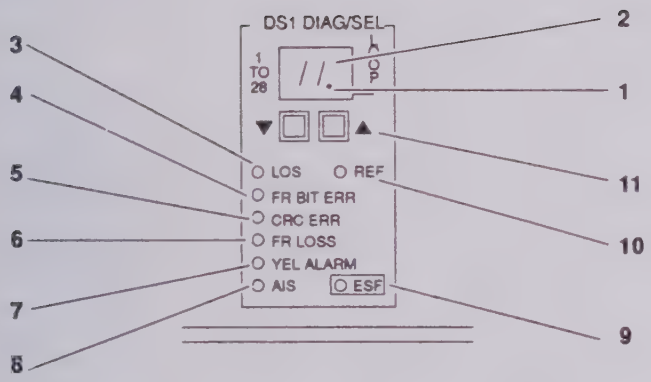
4 **X-BIT ALARM** - When lit, a remote alarm has been detected.

> **Note**
> An X-bit alarm is declared when the X-bit state is 0 for over 1 second while framing prevails.

5 **AIS** - When lit, an AIS signal was detected for 100μs or longer.

> **Note**
> An AIS signal consists of an unframed all-ones pattern.

6 **Legend** - This table lists the DS2 group corresponding to the DS1 group selection.



ure 2-5 DS1 Diagnostics Controls and Indicators

LOOP - The LED lights when the FEAC (Far End Alarm and Control) DS1 loopback code (for the selected DS1) is detected in the DS3 signal. (This applies only in the C-bit parity format.)

DS1 SEL - The two-digit display identifies the selected DS1 group number.

LOS - The loss of signal indicator flashes for 40 ms when the PCM in the selected DS1 group contains a string of 175 ±25 consecutive zeros. It is lit steadily when no signal is present in the selected DS1 group

4 **FR BIT ERR** - The frame bit error LED flashes for 40 ms when a frame bit error was detected in the monitored DS1 group. Only F_T bits are counted in NON-ESF modes.

> **Note**
> The FR BIT ERR LED is not operational if the FR LOSS LED (below) is lit.

5 **CRC ERR** - This LED flashes for 40 ms when a CRC-6 code error was detected. This results when 1-or-more bits were in error during transmission of the previous 24 frames. It is lit steadily when the CRC error rate exceeded 25/sec.

> **Note**
> The CRC error LED is operational only when the ESF format is detected.

R LOSS - The lit frame loss LED indicates hat framing is not acquired or is lost. This ccurs when

2 DS1 frame bits are corrupted within a group of 5 frame bits

'EL ALARM - This LED is lit when a emote or Yellow Alarm was detected.

Note
Yellow alarm is defined as follows

- ESF mode: the 4 Kbps data link contains a sequence of at least 10 consecutive 1111111100000000 words
- non-ESF mode: B2 is set to 0 for ≥40 ms in all DS0 channels

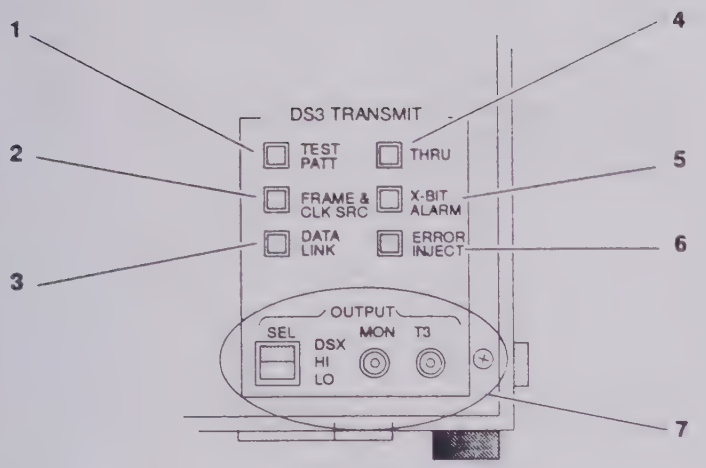
AIS - This LED is lit when an AIS signal was detected for 40 ms or longer.

Note
The AIS signal consists of an unframed all ones sequence.

ESF - This LED is lit when the received DS1 signal is in Extended SuperFrame format.

REF - This LED is off when there is a valid signal present at the DS1 IN jack on the 160A right panel. When lit, the DS1 Nput is absent.

Up/Down - Each depression of the UP or DOWN key changes the monitored DS1 digroup number by one in the selected direction. Roll-over occurs between DS1 groups 1 and 28 when changes are made continuously in one direction. If a key is held for over one second, the selected numbers change at the rate of 3 counts/sec.



ure 2-6 DS3 Transmit Controls and Indicators

TEST PATT - Press this key to select and display the selected transmitter bit pattern. The key remains lit while the transmitter is sending data.

FRAME & CLK SRC - Press this key to choose the transmit framing format: C-Bit or M13, and the clock source.

DATA LINK - This key is used to transmit messages on the C-BIT Parity Data Link. This capability is available only if your 160A is equipped with option 03.

THRU - Press this key to activate the THRU mode. This causes the transmitter to replicate the DS3 bit stream which is present at the DS3 PCM input jack. To exit THRU mode, first depress the THRU key and, within 700 ms, depress the TEST PATT key.

5 **X-BIT ALARM** - Press this key to alternatively activate and deactivate the transmission of remote alarm as follows:

On: X-bit alarm is introduced into the outgoing bit-stream (if bit-stream is framed). (the LED in this key is lit)

Off: no X-bit alarm is introduced into the bit-stream (the LED in this key is not lit)

6 **ERROR INJECT** - The ERROR INJECT menu is displayed by the VFDT when this key is momentarily depressed. With this menu, you may inject several types of errors into the DS3 output bit stream.

7 **SEL** - This three-position rocker switch sets the output level available at the MON and T3 jacks.

Note
The output impedance is nominal 75 ohm unbalanced.

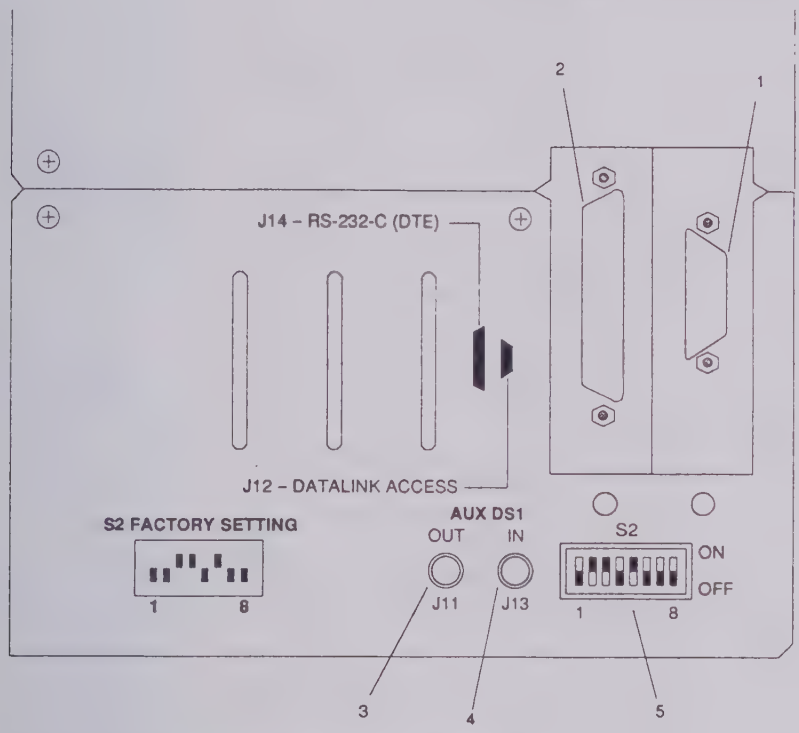
SX - This is a 0.48 Volt base-to-peak signal as found at a DS3 cross connect

II - This is a 0.91 Volt base-to-peak signal ke those found at the output of terminal quipment.

LO - This is the same as a HI level signal reduced in amplitude by 13.8 dB.

T3 - The output of the DS3 transmitter is presented at this jack.

MON - This jack presents the DS3 transmitter output at a level suitable for monitoring (approximately 20 dB below the T3 jack output level).



re 2-7 Side Panel Controls and Indicators - Right Side

RIGHT SIDE PANEL FEATURES

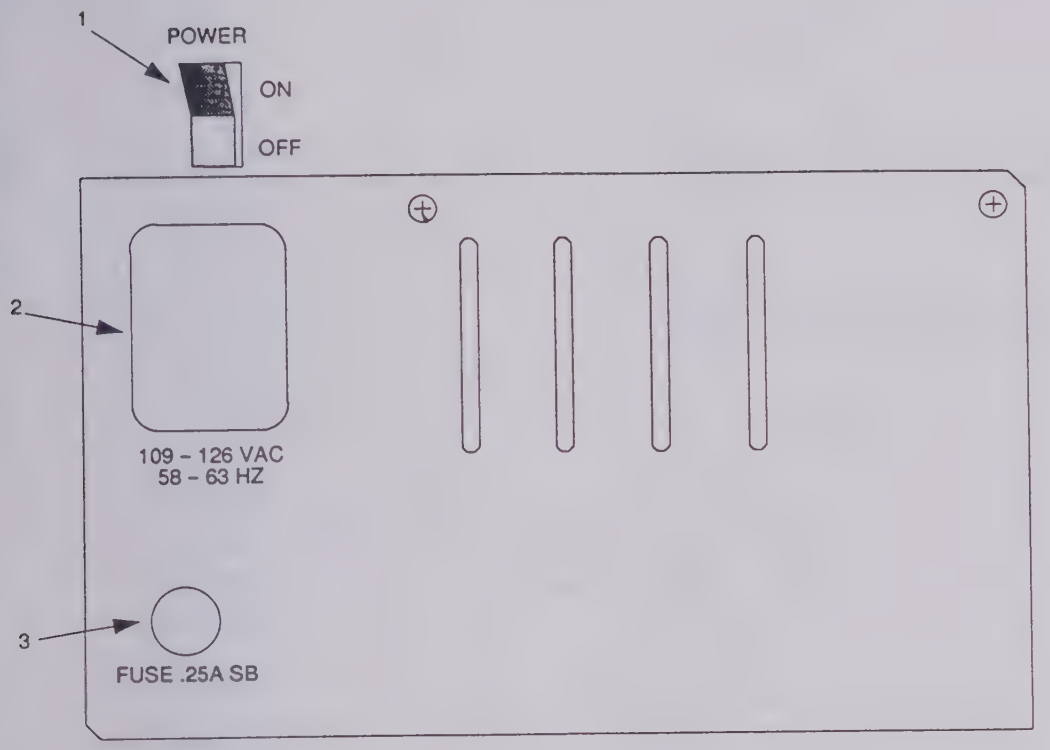
12 - The 9-pin connector provides access o the C-BIT Data Link messages.

14 - The **RS-232-C (DTE)** port is used for connecting a printer. This port is active when option 02 is installed on your 160A.

11 - The **AUX DS1 OUT** Jack delivers he DS1 group selected in the DS1 DIAG/SEL section. This signal is ormatted as a T1 bit stream having a evel of 0.0 dBDSX

4 **J13** - The **DS1 IN** jack accepts a 0 dBDSX level T1 signal. This signal is multiplexed by the DS3 transmitter into the DS1 group identified by the DS1 SEL/DIAG section.

5 **S2** - This 8-position DIP switch is used for entering several user selections. The setting for each switch position is displayed by the VFDT when the MODE/S2 menu is displayed.



gure 2-8 Side Panel Controls and Indicators - Left Side

.4 LEFT SIDE PANEL FEATURES

POWER - The main power switch.
Press this rocker switch

UP	to turn power ON
DOWN	to turn power OFF

AC Connector - Insert the power cord female end here.

FUSE - The main power fuse is accessed using a flat-blade screwdriver.

> **Note**
> Replace this fuse only with one of the exact rating and type as identified on the side panel.

APTER 3
TING STARTED

INTRODUCTION

chapter contains information to set up prepare the 160A for use. In addition, it cribes the self-diagnostic procedure for rating the three system-level keys in the trol and Measurements section. These are DSPL, MODE and TEST TIME keys

SETTING-UP AND INITIALIZING THE 160A

sical considerations

160A contains no position-sensitive ponents and can be operated in any tion. In typical use, the instrument is

laced upright on the floor resting on its ear panel feet, or
ying horizontally on a cart or shelf.

ensure effective convection cooling, do operate the unit while in its canvas ying case.

CAUTION
Do not expose the 160A to excessive humidity. Do not turn instrument power on while it is damp or wet. Injury to personnel or damage to the instrument may result.

Power

nnect power to the instrument and power n as follows:

1. Locate the AC power cord supplied in the front cover of the instrument.
2. Plug the cord female end into the instrument left side panel AC receptacle.
3. Plug the cord male end into a power outlet. This outlet must supply an AC voltage in the range 108 to 126 V_{RMS}.
4. Turn the power switch (found on the left side panel) to ON.

It is recommended that you not use a long extension cord to power the instrument. Such a cord may cause significant voltage drop resulting in unsatisfactory instrument operation.

Selecting operating modes

You may set S2 to suit your particular test conditions. Table 3.1 identifies each switch setting as well as the chapter in which detailed information can be found.

Note
S2 position 5 selects the real-time clock calibration mode, or normal mode. Before power-up, set this switch to the OFF position to invoke normal mode unless actually performing calibration.

ble 3-1. Switch S2 Functions and Chapter References

sition	Function	ON	OFF	Chapter
1	Remote Alarm (X-bit Alarm)	X = 1	X = 0	3
2	DS1 Format	B8ZS format	AMI format	3, 4
3	AIS	ATT format	Bellcore format	3,
4	Reframe	ATT criteria	Bellcore criteria	3
5	Normal/CAL	Calibration mode	Normal mode	3, 10
6	Auto-search Configuration	Auto-search invoked	Auto search not invoked	3
7	Not used			
8	Not used			

3 SELF-DIAGNOSTICS

on power-up the instrument automatically ecutes a comprehensive self-diagnostic utine. This routine verifies operational egrity of the internal system. If a non-tastrophic operational difficulty is countered, the self-diagnostic routine is spended and a message indicating the ture of the problem appears on the display. this point the user can

- use the unit despite an identified problem, or
- take corrective action.

an error occurs during the self-diagnostic utine, the controller displays the error type the VFDT. At this time, press softkey #3 XT) to continue operation.

hen a key is pressed, the controller resumes lf-diagnostics. This process repeats if ditional failures are detected.

no failures are detected during self-gnostics

- all front panel LEDs flash
- all display elements light
- screens [1] through [3] (below) are successively displayed for 1 second each

Screen [1]

```
T-COM 160A
DS3/DS1 TEST SET
```

Screen [2]

```
THE START UP TESTS
ARE COMPLETE
```

Screen [3]

```
ALL SYSTEMS ARE
GO !!
```

When the 3 second time-out period expires
- the DS3 STATISTICS key flashes
- the VFDT displays a screen like screen [4] and the instrument is automatically reset

This reset clears all impairment counters and sets the test timer to 00:00.

Screen [4]

```
DS3-NO ERRS DETECTED
          CNT SEC BER
```

(softkeys)
#1 #2 #3

The internal self test checks the 160A by internally generating and sending a test pattern to the receiver. It then sends a corrupted signal with a known error count to

the error counters. The possible error sages are listed below followed by a brief ription of their meaning. The words F TEST FAILURE -' appear on the top line he VFDT if an error occurs. One of the wing messages will appear on the bottom

T TMR FAILURE
The test timer does not operate roperly.

ME NOT FOUND
e framing format of the test pattern was ver recognized.

N SYNC ERROR
e receiver did not succeed in acquiring nchronization on the internally nsmitted test pattern.

E ERRS FOUND
ode errors were detected in the test ttern.

ERRS FOUND
errors were detected in the test pattern.

T ERRS FOUND
ame bit errors were found in the test ttern

ERRS FOUND
rity bit errors were found in the test ttern

PAR ERRS FND
BIT parity errors were detected in the test ttern

E ERRS FOUND
End Block Errors occurred during the test ttern transmission

TY CTR FAIL
ity bit error counter failure

COUNTER FAIL
error counter failure

IT CTR FAIL
me bit error counter failure

C-B PAR CTR FAIL
- C-BIT parity error counter failure

FEBE CTR FAIL
- Far End Block Error counter failure

Error counter failures indicate that a value other than the expected number of errors was counted during the corrupted signal portion of the self test.

If an error has occurred during the self test procedure, you should contact T-COM customer service at (415) 964-3415.

3.4 SYSTEM-LEVEL KEY OPERATION

Three keys control the operation of the entire unit. These system-level keys are located in the Controls and Measurements section (left side). System key operation is described below.

DSPL
This key controls the intensity of the VFDT display. Upon power-on, intensity defaults to 75%. Successive depressions of this key yield two additional intensity settings: 50% and 100%.

MODE
Press this key to access the mode menu. This menu allows you to customize the 160A for your particular application. The following five functions are included:

- setting the built-in clock and calendar
- viewing the installed software version number
- viewing settings and functions of all positions of DIP switch S2 (unit right side)
- selecting printer transmission parameters
- entering printer commands

Setting the Time
Set the time and date using the procedure below.

1. Press the MODE key to display screen [5] below. Note the cursor under TIME and the internal clock setting. (second line)

en [5]

```
E DATE SW S2 PRNT
06:22          SET
```

(softkey)
#3

ess SET (softkey #3). The display anges to Screen [6].

ess the ◂ and ▸ keys to position the rsor under the hour or minute digits.

ess the UP (#1) or DN (#2) softkeys to crement or decrement the selected hour minute.

n [6]

```
e :   21:06
      UP  DN  SET
```

(softkeys)
#1 #2 #3

llow these guidelines:

1. Set the time slightly ahead of the actual time.
2. When the actual time equals the set time, press the SET (#3) softkey. This updates the internal clock and returns the original MODE menu, screen [5].

ng the Date

the MODE menu displayed, set the date similar fashion to setting the time.

ress the ◂ and ▸ keys to position the ursor under the date (Screen [7]).

en [7]

```
me Date SW S2 PRNT
/10/91         SET
```

(softkey)
#3

Press the SET softkey to change the ate (Screen [8]).

Screen [8]

```
 Date : 11/10/91
(M/D/Y)  UP  DN  SET
```

(softkeys)
#1 #2 #3

3. With the date changed to the desired value, press the SET softkey. The VFDT displays the MODE menu with the new date (screen [5]).

> **Note**
> If you attempt to enter an out-of-range value, the entry will automatically be rejected. This applies to both the Date and Time.

Displaying the Software Version

With the MODE menu displayed, (screen [5]) position the cursor under the SW field. Line two of the menu displays the software version installed. See example screen [9]. Note that the softkeys are not active.

Screen [9]

```
Time Date SW S2 PRNT
     Version 1.2
```

Reading Switch S2 Settings

With the MODE menu displayed (screen [5]), you may view DIP switch S2 settings.

> **Note**
> S2 is located on the instrument right side.

> **Note**
> When a switch is set to
>
> - OFF, it is underlined
> - ON, it is not underlined.

Position the cursor under the S2 field of the MODE menu. This allows access to a series of screens. A screen is associated with each position of S2. The screen reveals the function of that position and the current switch setting.

these screens when you set the DIP to confirm the settings. The screens tically display the new setting as you DIP switch positions.

n 1 - Remote Alarm.
witch selects the X-bit criteria for the alarm (See screen [10]). Set this

to select the X-bit Alarm criteria of X-BIT equal to one

F to select the X-bit Alarm criteria of X-BIT equal to zero

[10]

```
e Date SW S2 Prnt
X-BIT = 0/1   NXT
```

(softkey) #3

n 2 - Format
witch selects the format for the signal ated at J11, DS1 OUT (on instrument side panel). Determine the desired , and then set this switch to

N to invoke B8ZS format

F to invoke AMI format

n [11]

```
e Date SW S2 Prnt
 AMI /B8ZS    NXT
```

(softkey) #3

on 3 - AIS
switch sets the desired AIS criteria (see n [12]). Set this switch

N to invoke ATT AIS format

F to invoke the additional Bellcore requirement for the AIS format that C-BITs must be set to zero

n [12]

```
e Date SW S2 Prnt
AIS BELL/ATT  NXT
```

(softkey) #3

Position 4 - Reframe

This switch selects the reframing criteria (see screen [13]). Set this switch

ON to invoke standard DS3 reframing criteria

OFF to invoke Bellcore recommended reframing criteria

The Bellcore reframing criteria has the following three additional requirements over ATT reframing:

1) C-BIT parity control bits must be zero

2) There must be correct parity

3) There must be less than 3 consecutive zeros

Screen [13]

```
Time Date SW S2 Prnt
/4 REFR BELL/ATT NXT
```

(softkey) #3

Position 5 -NORM/CAL

This switch should be OFF unless you are calibrating the 160A real time clock. Settings for this switch are as follows:

ON to invoke real time clock calibration mode - screen [14]

OFF to invoke normal mode - screen [15]

Screen [14]

```
Time Date SW S2 Prnt
/5 OPER NORM/CAL NXT
```

(softkey) #3

Screen [15]

```
Time Date SW S2 PRNT
/5 OPER NORM/CAL NXT
```

(softkey) #3

lote
AL mode is for instrument alibration only. It is not for normal se. See chapter 11 for calibration nstructions.

sion 6 - Auto Search.

osition 6 is used to configure the DS1 ver to search or not to search for any rn in the DS3 transmitter library. Set to

N to search for a pattern other than the pattern selected in the DS3 transmitter (Screen [16])

FF to search only for the pattern currently selected in the DS3 transmitter (screen [17])

en [16]

```
ne Date SW S2 PRNT
 Auto-Srch ON  NXT
```

(softkey)
#3

en [17]

```
ne Date SW S2 PRNT
 Auto-Srch OFF NXT
```

(softkey)
#3

NOTE
When auto-search is enabled, the pattern identification process is only carried out upon entry of a RESET command.

switch S2 positions 7 and 8 are not used is time

ring Reports

section applies to option 02-equipped s only (RS-232-C option). To determine if on 02 is installed:

Position the cursor under PRNT in the node menu.

2. If option 02 is absent, screen [18] is displayed. If it is installed, screen [19] (or similar) is shown.

Screen [18]

```
Time Date SW S2 PRNT
 OPTION 02 REQUIRED
```

Screen [19]

```
Time Date SW S2 PRNT
SUM. REPORT   GO NXT
```

(softkeys)
#2 #3

With option 02 installed, you can access a series of commands allowing you to configure the RS-232-C port and to down-load reports to a printer or terminal. Chapter 7 gives more details on using option 02.

The first command screen, screen [19] appears above.

Press the GO softkey to print a summary report. Press the NXT key to display the next command screen [20].

Screen [20]

```
Time Date SW S2 PRNT
RCVR STATUS   GO NXT
```

(softkeys)
#2 #3

Press the GO softkey to print a receiver status report. Press the NXT key to display the activity report time resolution screen [21]

Screen [21]

```
Time Date SW S2 PRNT
REPRT TMR 01 SET NXT
```

(softkeys)
#2 #3

In screen [21], the report time resolution is 1 minute. You can select a value from 1 to 99 minutes. The time resolution selection defines the minimum time between successive

ng entries in the activity report. Consider llowing examples :

me that over the next three minutes the rment activity detected by the unit is

3bit errors during the first minute
2bit errors during the second
nute, and
2bit errors during the third minute
e REPRT TMR is 01, the printed report s:

TE	TIME	EVENTS	DS3 COUNTS
)7/91	15:03	BIT ERR	3
)7/91	15:05	BIT ERR	2

e REPRT TMR is 03, the printed report s:

TE	TIME	EVENTS	DS3 COUNTS
)7/91	15:05	BIT ERR	5

s the SET softkey in screen [21]. This es screen [22] to be displayed. Screen allows you to set the timer using the UP DN softkeys.

en [22]

```
TIVITY REPORT  01
MER    UP  DN  SET
```

▬ #1 ▬ #2 ▬ #3 (softkeys)

the desired value entered, press the SET to produce screen [21] displaying the value.

s the NXT softkey in screen [21]. This rns you to display screen [19].

232-C Port Parameters

s the ALT SEL key to display screen [23]. screen displays RS-232-C port meters

aud rate (4800)
umber of data bits (7)
arity (none)
umber of stop bits (2)
ow control (NONE)

Screen [23]

```
  RS-232-C  BEEPER
4800 7 N 2 NONE SET
```

▬ #3 (softkey)

Press the SET softkey in screen [23] to select the RS-232-C port parameters. Screen [24] displays available baud rates. The current selection is underlined. Use the ◂ or ▸ arrows to select the desired baud rate.

Screen [24]

```
BAUD RATE: 300  1200
2400 4800 9600   NXT
```

▬ #3 (softkey)

Press the NXT softkey in screen [24] to display screen [25]. This screen displays the available number of data bits per ASCII character. The current selection is underlined. Use the ◂ or ▸ arrows to select as appropriate.

Screen [25]

```
Data Bits   7  8
                NXT
```

▬ #3 (softkey)

Press the NXT softkey in screen [25] to display screen [26] which displays the parity selections. The current selection is underlined. Use the ◂ or ▸ arrows to select as appropriate.

Screen [26]

```
PARITY:NONE ODD EVEN
                NXT
```

▬ #3 (softkey)

Press the NXT softkey in screen [26] yields screen [27]. This screen displays selections for the number of stop bits in each ASCII character. The current selection is

rlined. Use the ◂ or ▸ arrows to select ppropriate.

en [27]

```
op Bits: 1   1.5   2
                  NXT
```

(softkey)
#3

s the NXT softkey in screen [27] to lay screen [28]. This shows flow control ons.

een [28]

```
'LOW CONTROL: NONE
)SR CTS XON/OFF NXT
```

(softkey)
#3

ss the NXT softkey in screen [28] to play screen [23] with new RS-232-C port ameters. See chapter 7 for further printer up instructions.

per

beeper will sound (if on) each time an airment is detected. The alarm will not nd when LOS, FR LOSS, AIS, IDLE, or X- ALARM conditions are detected or SYNC st.

h screen [23] showing, place the cursor er BEEPER to bring up screen [29]. Press tkeys #2 and #3 to set the beeper ON or F as desired.

een [29]

```
 RS-232-C  BEEPER
eeper/Alarm: ON OFF
```

(softkeys)
#2 #3

ST TIME

ss the TEST TIME key to display screen], or similar. This screen displays:

elapsed time since the last reset and
the programmed test period

Screen [30]

```
000:15:00 MAX    CONT
000:00:45 ELAP'D GO
```

(softkey)
#3

In the top line of this screen, the CONT field or the 000:15:00 MAX field is underlined. When the
CONT field is underlined, the test period is unlimited. When the 000:15:00 MAX field is underlined, a test time of 15 minutes applies

Move the underline using the ◂ or ▸ key. Screen [30] also shows that 45 seconds have elapsed since the last reset. When

a) CONT field is underlined, softkey #3 is as shown in screen [30]. Press the GO softkey to reset the instrument and initialize the test timer.

b) 000:15:00 MAX is underlined, the header of softkey #3 changes to SET; this allows you to set test time to any value in the range 000:00:00 to 999:59:59. When you press SET, a screen similar to screen [31] replaces screen [30].

Screen [31]

```
TEST    000:01:00
TIME      UP  DN  GO
```

(softkeys)
#1 #2 #3

Set the desired time using the ◂, ▸ and UP/DN keys as described for setting the clock. When the entry is complete, press GO to start the test timer. When the SET screen is not displayed, press the RESET key combination. Also, press GO to display screen [30] with the new test time.

If the timer times out during test, all impairment event counters stop tallying new counts, and all error rate values freeze

This is indicated by a flashing T on the DS1 STATS screen: .

time is stored in battery-backed RAM
the unit is turned off; it needs not be
ered the next time the instrument is
ed up.

APTER 4
DS2/DS1 MONITORING AND ORMANCE ANALYSIS

INTRODUCTION

is chapter you will find:

- n overview of real-time DS3/DS2/DS1 ansmission monitoring
- irections to set-up the 160A for S3/DS2/DS1 monitoring
- description of the real-time DS3 iagnostic and impairment statistics apabilities
- description of the real-time DS2 iagnostic and impairment statistics apabilities
- description of the real-time DS1 iagnostic and impairment statistics apabilities
- n-service monitoring application nformation

re using the information in this chapter, recommend that you study Chapter 3 to oughly familiarize yourself with the tions of the 160A controls and indicators.

REAL-TIME DS3/DS2/DS1 TRANSMISSION MONITORING

160A is equipped with a DS3 diagnostic iver to provide real-time monitoring and to uate the transmission performance of any formatted signal as typically found at -3 bays, M1-3 multiplexers and test erators. A DS2 diagnostics section acterizes the DS2 group indirectly cted by the DS1 group selector. A DS1 nostics section characterizes any one of DS1 groups directly selected and layed by the DS1 group selector.

SETTING-UP THE PCM INPUT SELECTION

DS3 input section is compatible with the l found either at the DSX-3 bay or at the signal source output (typically an M1-3 tiplexer or a test generator). In this case, signal is usually referred to as "Hi"; its 368 MHz component is approximately 5 stronger than at the DSX-3 jack. The t circuit selection (SEL) enables the front to either terminate the line, to provide a impedance bridge or to comply with the rface requirements of monitor access jacks. (At the monitor jack, the level is attenuated by slightly over 20 dB.)
When patching the 160A DS1 Receiver PCM INPUT jack at the DSX bay, set INPUT SEL as follows:

Jack type (Ohms)	Selection	Impedance
output	TERM	75
bridging	BRDG	635
monitor	MON	75

Warning
When the bridging mode is selected, the 75 Ohm coax cable length from the access point to the 160A DS3 input must not exceed 3 feet. Failure to observe this limitation can cause severe reflections on the monitored circuit resulting in its failure.

4.4 PERFORMING REAL-TIME DS3 TRANSMISSION MONITORING

When the 160A PCM input selection is properly set, the DS3 Diagnostic Receiver analyzes the applied PCM signal and displays its status in real time with dedicated LEDs and with the VFDT.

4.4.1 DS3 Diagnostic LEDs

The diagnostic information supplied by each LED is given below. Unless otherwise stated, the LEDs will light for 40 ms if one or more errors occurred during the previous 40 ms.

LOS LED:
- is steadily lit when no DS3 bit stream is present at the jack, or if the signal amplitude is below the minimum acceptable level or if the line is said to be oscillating
- flashes on when >175 +/- 25 consecutive 'zeros' are detected

E ERR LED:
lashes on briefly for detected
33ZS code violations which may be 3
onsecutive zeros or illegal bipolar
iolations.
teadily on when the code error density
eeds
1 CODE ERR/40 ms

ERR:
lashes for 40 ms when one or more parity
errors are detected in a 40 ms window of
he DS3 input signal
steadily lit when the parity error density
exceeds 1 PAR ERR/40 ms

BIT ERR LED:
flashes on briefly for detected frame bit
errors while framing prevails. Only F bit
error occurrences are displayed
s steadily lit when the frame bit error rate
exceeds 1 error/ 40 ms while framing
prevails.

LOSS LED:
is off when framing prevails
flashes on briefly each time framing is lost
and quickly reacquired. Frame loss
requires one or more of the following
conditions:

1. 3 corrupted frame bits in a group of 16
2. 3 corrupted M-bit patterns in a row

is on while framing is lost

ERR LED:
flashes on for one or more detected bit
errors (in the previous 40 ms) once
pattern synchronization prevails (SYNCH
LED is green)
is steadily lit when the bit error rate
exceeds 1 bit error/40 ms while pattern
synchronization prevails
is turned off otherwise

NCH LED:
is off if pattern synchronization has never
been achieved
is steadily lit green when the receiver bit
pattern is synchronized to the incoming bit
pattern
is red when pattern synchronization is lost

LED:
is lit while the AIS code is detected for a
minimum duration of 6 ms. The AIS
pattern consists of the framed sequence
of 1010.... If DIP switch S2/3 is set to
OFF, the lighting of the LED has the
additional Bellcore requirement for all DS3
C-bits to be set to zero.

IDLE:
- is lit while the IDLE signal (framed 1100...) is detected for a minimum duration of 6 ms.

X-BIT LED:
- is on only when the remote alarm as conveyed by the state of the X bit is detected for over one second while framing prevails. The selection of alarm for X=1 or 0 is made with dip switch S2/1.
- is off otherwise

C-BIT:
- is on when the DS3 signal is in the C-Bit Parity framing format. The format is automatically detected by the 160A.

PAR ERR:
- is lit when a C-Bit parity (C_p bit) error is detected. C-Bit parity errors can only occur when the system is in the C-Bit parity framing format. C-Bit parity errors are different than parity errors discussed previously.

FEBE:
- is lit when a far end block error (FEBE) is detected. These errors can occur only when the system is in the C-Bit parity framing format.

4.4.2 DS3 Statistics

Additional DS3 measurements displayed in real-time by the VFDT are given below. These measurements are obtained by momentarily depressing the DS3 STATISTICS key in the Control and Measurements section.

The data displayed when the DS3 STATISTICS key is depressed are accumulated and/or processed during the test time period only. This period is selected from the TEST TIME menu; it is started when the RESET keys are momentarily depressed. Refer to chapter 3 for instructions on setting the TEST TIME.

Upon depressing the DS3 STATISTICS key, screen [1] is displayed if no errors have been detected during the test time period.

n [1]

```
-NO ERRS DETECTED
      CNT SEC BER
```

(softkeys)
#1 #2 #3

ors have occurred during the test time
l, screen [2] is displayed

n [2]

```
-HOLD ALT SEL FOR
TORY. CNT SEC BER
```

(softkeys)
#1 #2 #3

llowing the instructions on the screen,
ng the green ALT SEL key, the
priate LEDs in the DS3 DIAGNOSTICS
on will light as long as the ALT SEL key
epressed. These indicate all the
ostic conditions which have occurred on
DS3 bit stream during the test time
d. Screen [3] is displayed while ALT SEL
d in the above set of circumstances.

en [3]

```
DISPLAYING DS3
    HISTORY
```

of the DS3 STATISTICS can be viewed
g the test period as well as after the test
d has timed out. These statistics can
be down-loaded to a printer if the 160A
uipped with option 02.

3 CNT STATITISTICS

n you depress the DS3 CNT softkey #1,
en [4] is displayed on the VFDT and the
SEL key illuminates; depressing it returns
to the main screen (i.e. screen [1]).

en [4]

```
PARITY ERR
     0          NXT
```

(softkey)
#3

en [4] shows the number of parity errors
have occurred since the start of the test
d. Each time the PAR ERR in the
nostic receiver flashes, the count
increments by the appropriate number if the programmed test period has not yet elapsed.

Depressing the NXT softkey on screen [4] brings up screen [5]. This screen yields the number of frame bit errors that have occurred since the start of the test period. Again, these counts increment each time the corresponding LED in the DS3 diagnostic receiver section flashes during the test. Note: the counter is disabled while framing is lost. If framing is not acquired, N/A will appear in place of the count.

If the DS3 bit stream is in C-Bit parity framing format, screen [5A] is displayed by depressing the NXT softkey in screen [5]; screen [6] appears otherwise.

Screen [5]

```
FR B ERR
    0          NXT
```

(softkey)
#3

Screen [5A]

```
C-BIT PAR  FEBE
    0        2    NXT
```

(softkey)
#3

The C-Bit parity error counter is incremented by one count for each detected C-Bit parity error. The FEBE counter is incremented by one count for each detected far end block error. Both counters are disabled when framing is lost or the C-Bit parity framing format is not detected (i.e. C-BIT LED is not lit).

Screen [6] is obtained by depressing the NXT softkey in screen [5] or [5A].

Screen [6]

```
BIT ERR (1100)
     0          NXT
```

(softkey)
#3

Bit errors are detected and counted only if the diagnostics receiver is synchronized to the incoming bit pattern (SYNC light is green). The screen also indicates the bit pattern to which the receiver is synchronized, if any.

example, screen [6] indicates that the receiver is synchronized on the DS3 IDLE ern (1100...). If no pattern is recognized, NE) appears next to BIT ERR and N/A aces the count.

n the auto-search mode is disabled (S2/6 OFF), the receiver uses the transmitter's ern as reference for synchronization. If auto-search mode is enabled (S2/6 set the receiver sequentially uses each of the erns in the DS3 transmitter library as rence for synchronization.

te:
the end of the test period, a flashing T pears above NXT in the previous four reens to tell you the test has timed t.

3 SEC RESULTS
ssing the SEC (seconds) softkey in screen or [2] and using the NXT softkey brings up sequence of displays shown in screens [7] ugh [9].

een [7]

```
ERR-SEC FR-L-SEC
   4          0    NXT
```

– (softkey)
3

een [8]

```
IS-SEC XBIT A-SEC
  5           0    NXT
```

– (softkey)
3

een [9]

```
YNC L-SEC (1100)
       5          NXT
```

– (softkey)
3

een [9A]

```
IT ERR-SEC (1100)
       1          NXT
```

– (softkey)
3

Screen [9B]

```
CODE ERR-SEC
      0          NXT
```

– (softkey)
3

Screen [9C]

```
PAR ERR-SEC
      4          NXT
```

– (softkey)
3

Screen [7] displays the number of errored seconds and frame loss seconds. An errored second is a second in which one or more of the following events have occurred: LOS, CODE ERR and/or PARITY ERR. A frame loss second is a second during which framing was lost. Frame loss results when 3 frame bits in a group of 16 or fewer are corrupted or 3 consecutive M-Bit patterns are corrupted.

Screen [8] shows the number of seconds the AIS pattern and the X-BIT alarm code have been received during the test period.

Screen [9] displays sync loss seconds and the bit pattern on which the receiver is synchronized (only if the receiver is or was synched on a pattern since the last RESTART).

Screens [9A], [9B] and[9C] break down the errored seconds into bit errored seconds, code error seconds and parity errored seconds respectively.

- DS3 BER STATISTICS
The BER softkey #3 of screen [1] or [2] gives you access to a series of displays that yield the bit error rate based on the number of bit errors. Screens [10] through [12] illustrate these measurements. Note: Screens [11A] and [11B] are only displayed if the C-BIT parity framing format is used. Screen [11] will show N/A if frame was not acquired. Screen [12] will display N/A if the receiver is not synchronized on the pattern.

The error rate computation is performed only when the number of accumulated errors exceeds 3. If this is not the case, or if the

rate is smaller than 0.1 x 10^{-9}, the rement value field reads "LOW R". If the error rate exceeds 9.9 x 10^{-3}, measurement field will read "HIGH R". Table 4-1 lists the measurement s.

ate computations are as follows:

TY BER
R ERRs/(# Framed secs x 44,736,000)

IE BER
B ERRs/(# Framed secs x 263,153)

PARITY BER
BIT ERRs/(# Framed secs x 44,736,000)

BER
BEs/(# Framed secs x 44,736,000)

UNFRAMED)
T ERRs/(# Synched secs x 44,736,000)

FRAMED)
T ERRs/(# Synched secs x 44,210,000)

e number of errors for a particular BER rs 999,999, the BER will flash, ating that it may not be entirely accurate.

en [10]

```
PARITY BER
  LOW ERROR      NXT
```

_ (softkey)
#3

en [11]

```
FRAME BER
2.2 x 10^-9      NXT
```

_ (softkey)
#3

en [11A]

```
BIT PARITY BER
  LOW ERROR      NXT
```

_ (softkey)
#3

Screen [11B]

```
FEBE BER
2.1 x 10^-9      NXT
```

_ (softkey)
#3

Screen [12]

```
BER (1100)
 LOW ERROR       NXT
```

_ (softkey)
#3

4.5 PERFORMING REAL-TIME DS2 TRANSMISSION MONITORING

When a DS3 signal is applied to the INPUT PCM jack of the DS3 diagnostics section, it is demultiplexed by the 160A. The DS2 DIAGNOSTICS section analyzes the DS2 group which is indirectly selected by the DS1 group selector and displays its status in real time with dedicated LEDs and with the VFDT.

4.5.1 DS2 Diagnostic LEDs

The diagnostic information supplied by each LED is given below. Error LEDs will light for 40 ms if one or more errors occurred during the previous 40 ms window.

LOS LED:
- flashes on when >175 +/- 25 consecutive 'zeros' are detected in the selected DS2 group
- is steadily lit when the signal is lost

FR BIT ERR LED:
- flashes on briefly for detected frame bit error occurrences while framing prevails. Only F bit error occurrences are displayed.
- is steadily lit when the frame bit error rate exceeds 1 error/ 40 ms while framing prevails.

FR LOSS LED:
- is off when framing prevails
- flashes on briefly each time framing is lost and quickly reacquired
- is on while framing is lost

  Frame loss occurs when 2 frame bits are corrupted in a group of 5 frame bits or when 2 M-bit patterns are corrupted in a row. Framing recovery requires the detection of 8 consecutive uncorrupted frame bits.

ALARM LED:
on only when the remote alarm as onveyed by a zero state of the X bit is etected for over one second while aming prevails.
off otherwise

ED:
lit while the AIS code is detected for a inimum duration of 100 us. The AIS attern consists of an all ones pattern.

DS2 Statistics

tional DS2 measurements displayed in ime by the VFDT are given below. These surements are obtained by momentarily essing the DS2 STATISTICS key in the rol and Measurements section.

data displayed when the DS2 TISTICS key is depressed are mulated and/or processed during the test period only. This period is selected from EST TIME menu; it is started when the ET keys are momentarily depressed. r to chapter 3 for instructions on setting EST TIME.

n depressing the DS2 STATISTICS key, en [13] is displayed if no errors have been cted during the test time period.

en [13]

```
2-NO ERRS DETECTED
        CNT SEC BER
```

(softkeys)
#1 #2 #3

rrors have occurred during the test time od, screen [14] is displayed

en [14]

```
2-HOLD ALT SEL FOR
STORY. CNT SEC BER
```

(softkeys)
#1 #2 #3

following the instructions on the screen holding the green ALT SEL key, the opriate LEDs in the DS2 DIAGNOSTICS tion will light as long as the ALT SEL key depressed. These indicate all the gnostic conditions which have occurred on DS2 bit stream during the test time od. Screen [15] is displayed during the ALT SEL depression in the above set of circumstances.

Screen [15]

```
DISPLAYING DS2
   HISTORY
```

Any of the DS2 STATISTICS can be viewed during the test period as well as after the test period has timed out. These statistics can also be down-loaded to a printer if the 160A is equipped with option 02.

- DS2 CNT STATITISTICS
When you depress the DS2 CNT softkey #1, screen [16] is displayed on the VFDT and the ALT SEL key illuminates; depressing it returns you to the main screen (i.e. screen [13]).

Screen [16]

```
FR B ERR
    0
```

Screen [16] shows the number of frame bit errors that have occurred since the start of the test period. Each time the FR B ERR in the DS2 diagnostic receiver flashes, the count increments if the programmed test period has not yet elapsed and framing has not been lost.

- DS2 SEC STATITISTICS
Pressing the SEC (seconds) softkey in screen [13] or [14] and using the NXT softkey brings up the sequence of displays shown in screens [17] and [18]. It also lights the ALT SEL key. Depressing it returns you to screen [13].
Screen [17]

```
ERR-SEC FR-L-SEC
   3          0   NXT
```

(softkey)
#3

Screen [18]

```
AIS-SEC XBIT A-SEC
   1          0   NXT
```

(softkey)
#3

Screen [17] displays the number of errored seconds and frame loss seconds. An errored

d is a second in which DS2 LOS has red. A frame loss second is a second which 2 frame bit errors in a group of ewer are corrupted, or 2 consecutive M-tterns are corrupted.

n [18] shows the number of seconds AIS pattern and the X-BIT alarm code been received during the test period.

BER STATISTICS

BER softkey #3 of screen [13] or [14] you access to a display that yields the ror rate based on the number of frame errors. Screen [19] illustrates this urement.

error rate computation is performed only the number of accumulated errors eds 3. When this is not the case, or if rror rate is smaller than 0.1×10^{-9}, the urement value field reads "LOW R". If the error rate exceeds 9.9×10^{-3}, measurement field will read "HIGH R". Table 4-1 lists the measurement s.

following equation is used to calculate rame bit error rate:

ME BER
B ERRs/(# Framed secs x 128,808)

e number of errors for the FRAME BER ers 999,999, the BER will flash, ating that it may not be entirely accurate.

en [19]

FRAME BER 2.2×10^{-9} NXT

– (softkey) #3

PERFORMING REAL-TIME DS1 TRANSMISSION MONITORING

DS1 DIAG/SEL section allows you to t one of the 28 DS1 groups ltiplexed from the input DS3 bit stream. selected DS1 is analyzed by the 160A its status is displayed in real time with ated LEDs and with the VFDT. The en DS1 is also available at the DS1 OUT on the side of the 160A. The format of signal can be set to AMI or B8ZS via the witch S2/2.

4.6.1 DS1 Diagnostic LEDs

The diagnostic information supplied by each LED is given below. The error LEDs will light for 40 ms if there is one or more error in the previous 40 ms.

LOOP LED:
- This LED is the decimal point in the DS1 digroup selector. It lights when the Far End Alarm and Control (FEAC) bits in the DS3 input signal are carrying the line loopback code for the selected DS1 group.

LOS LED:
- flashes on when 175 +/- 25 consecutive 'zeros' are detected in the DS1 group
- is steadily lit when the signal is lost

REF LED:
- is off when the DS1 INPUT signal is present
- is steadily lit when the signal is lost

FR BIT ERR LED:
- flashes on briefly for detected occurrences of frame bit errors while framing prevails. (only F_T bits are counted in non-ESF modes)
- is steadily lit when the frame bit error rate exceeds 1 error/ 40 ms while framing prevails.

CRC ERR LED:
- flashes on briefly for detected occurrences of CRC code errors while ESF framing prevails
- is steadily lit when the CRC code error rate exceeds 1 CRC/ 40 ms while ESF framing prevails

FR LOSS LED:
- is off when framing prevails
- flashes on briefly each time framing is lost and quickly reacquired. Framing is lost when 2 out of 5 DS1 frame bits are corrupted.
- is on while framing is lost

YEL ALARM LED:
- is on only when the SF yellow alarm code is present for over 30 ms or when the ESF yellow alarm code is received at least 14 consecutive times
- is off otherwise

AIS LED:
- is lit while the all-ones (unframed) code is detected for a minimum duration of 40 ms.

LED:
steadily lit to indicate that the framing ormat of the monitored bit stream is ESF. he LED is not lit when the monitored bit tream is unframed or has any framing ormat other than extended superframe.

2 DS1 Statistics

ctional DS1 measurements displayed in ltime by the VFDT are given below. These surements are obtained by momentarily cessing the DS1 STATISTICS key in the trol and Measurements section.

vith the DS3 and DS2 STATISTICS keys e data displayed when the DS1 TISTICS key is depressed are mulated and/or processed during the test period only. This period is selected from TEST TIME menu; it is started when the ET keys are momentarily depressed. r to chapter 3 for instructions on setting TEST TIME.

n depressing the DS1 STATISTICS key, en [20] is displayed if no DS1 errors have n detected during the test time period.

en [20]

```
1-NO ERRS DETECTED
      CNT SEC BER
```

(softkeys)
#1 #2 #3

rrors have occurred during the test time od, screen [21] is displayed

en [21]

```
1-HOLD ALT SEL FOR
STORY. CNT SEC BER
```

(softkeys)
#1 #2 #3

following the instructions on the screen, ling the green ALT SEL key, the ropriate LEDs in the DS2 DIAGNOSTICS tion will light as long as the ALT SEL key depressed. These indicate all the nostic conditions which have occurred on DS3 bit stream during the test time od. Screen [22] is displayed during the SEL depression in the above set of umstances.

Screen [22]

```
DISPLAYING DS1
HISTORY
```

Any of the DS1 STATISTICS can be viewed during the test period as well as after the test period has timed out. These statistics can also be down-loaded to a printer if the 160A is equipped with option 02.

- DS1 CNT STATISTICS
When you depress the CNT softkey in screen [20] or [21], screen [23] is displayed on the VFDT. It displays the bit-by-bit slippage and the frame slippage count (if there is a DS1 reference signal introduced to the DS1 IN jack) that have occurred since the start of the test period. The slippage is displayed in real time; it is representative of the instantaneous difference in the clock rates taking place between the DS1 signal applied at the DS1 INput, on the side panel, and the selected DS1 signal demultiplexed from the DS3 INPUT PCM. To return to the main DS1 statistics menu (screen [20]), press ALT MENU.

Screen [23]

```
SLIPPAGE  CNT:    0
 =------⊥----     NXT
```

(softkey)
#3

The slippage display consists of a stack on the left and a scale under the SLIPPAGE heading. Together, the marker on the scale and the height of the stack represent the instantaneous delay between a reference bit position on the two PCM bit streams. When the two observed bit streams have precisely the same clock frequency and the instrument has been reset, the stack is empty and the marker sits on the middle of the scale.

If the clock frequency of the bit stream presented at the diagnostics receiver input is higher than the clock frequency of the bit stream presented at the DS1 IN jack, the stack increases in height one layer at a time. Each layer represents one bit of slippage. When the stack reaches its full height, it is emptied and the marker on the scale advances to the right, one position. This process repeats itself until finally the marker falls off the edge of the scale. At the same time, the (frame slip) COUNT is incremented.

clock frequency of the bit stream at the diagnostics receiver is lower e clock frequency of the signal applied reference DS1 INput, the stack ses in height by one layer for each bit and the marker moves from the center eft edge of the scale. The stack is six gh and there are 32 horizontal marker ns between the center and edges of ale. Each count therefore represents pped bits.

e on a T1 passing through an office in can be checked quite easily. Only a r feed is required from the DS3 signal. rom any source that is referenced to a n one clock, such as a feed from a rk switch, supplies the reference signal. 1 is inserted into J13 of the 160A and annel to be tested is selected in the iagnostics section. Selecting slippage DS1 CNT will give a quick test of the . This process works in reverse as

hing T may appear near NXT to indicate ut as was described for screen [6].

ssing the NXT softkey on screen [23] up screen [24]. This screen yields the er of frame bit errors that have occurred the start of the test period. These s increment each time the sponding LED in the DS1 DIAG/SEL n flashes during the test.

n [24]

```
 FR B ERR
     10          NXT
```

_ (softkey)
#3

ny system selection, framing bit errors Ft nonitored and captured. Framing bit error ting is disabled during framing loss to false counting. If framing is lost over a ficant portion of the monitored period, rame bit error count may be lower than Screen [25] is displayed by depressing in screen [24]. This screen is only ayed if the selected DS1 is in the ESF ng format.

Screen [25]

```
      CRC ERR
        51          NXT
```

_ (softkey)
#3

It counts the number of CRC errors that have occurred since the start of the test period and increments each time the CRC ERR LED is lit.

CRC errors can only be found when monitoring ESF formatted bit streams. An error is detected when the 6-bit signature received along with an extended superframe does not match the 6-bit word computed by the diagnostic receiver for the same extended superframe. When this is the case, it is accurate to state that one or more bits have been corrupted in a block of 4614 bits.

> **Note**
> CRC errors are only counted when there is ESF framing. If framing is lost over a significant part of the monitored period, the CRC count is then lower than fact.

- DS1 SEC STATISTICS

Pressing the SEC (seconds) softkey and using the NXT softkey in screens [20] or [21] brings up the sequence of displays shown in screens [26] through [28].

Screen [26]

```
  ERR-SEC FR-L-SEC
     0          2    NXT
```

_ (softkey)
#3

Screen [27]

```
      SES      CSES
      20          0  NXT
```

_ (softkey)
#3

Screen [28]

```
AIS-SEC YL ALM-SEC
   2           0    NXT
```

_ (softkey)
#3

...en [26] displays the number of errored ...nds and frame loss seconds. An errored ...nd is a second in which DS1 LOS or CRC ...have occurred. A frame loss second is a ...nd during which 2 frame bit errors in a ...p of 5 or fewer are corrupted.

...en [27] displays the number of severely ...ed seconds and consecutive severely ...ed seconds. A severely errored second is ...cond in which one or more of the ...wing events have occurred: >11 FR BIT ..., >320 CRC ERR, FR LOSS. The ...ecutive severely errored seconds counter ...cremented by one when three or more ...rely errored seconds occurred.

...marks
...ored seconds and severely errored ...onds are mutually exclusive.

...hen unframed pattern synchronization ...vails, the resulting frame loss does not ...use the errored second counter to ...rement.

...en [28] shows the number of seconds ...AIS (All ones) pattern and the yellow ...n code have been received during the test ...od. To return to the main DS1 screen, ...s ALT SEL.

...1 BER STATISTICS
...BER softkey #3 of screen [20] or [21] ...s you access to a display that yields the ...error rate based on the number of frame ...rrors and CRC errors (if selected DS1 is in ...ESF framing format) screen [29] and [30] ...trate these measurements.

...error rate computation is performed only ...n the number of accumulated errors ...eeds 3. When this is not the case, or if ...error rate is smaller than 0.1×10^{-9}, the ...surement value field reads "LOW ...OR". If the error rate exceeds 9.9×10^{-3}, ... measurement field will read "HIGH ...OR". Table 4-1 lists the measurement ...ges.

...following equations are used to calculate ...bit error rates:

...ME BER (ESF)
...R B ERRs/(# Framed secs x 2000)

...ME BER (SF)
...R B ERRs/(# Framed secs x 4000)

CRC BER
= CRC ERRs/(# Framed secs x 1,544,000)

If the number of errors for a particular BER renders 999,999, the BER will flash, indicating that it may not be entirely accurate.

Screen [29]

```
FRAME BER
1.3 x 10^-9        NXT
```

– (softkey)
#3

Screen [30]

```
CRC BER
5.1 X 10^-9        NXT
```

– (softkey)
#3

MEASUREMENT SUMMARY

4-1 summarizes all of the diagnostic ver measurements that are displayed. It gives error criteria and/or the range of y.

Table 4-1. Measurement definitions, ranges and criteria

urement	Definition	Range/Criteria
	DS3 DIAGNOSTICS	
	Loss of signal	
E ERR	B3ZS code violation	
ERR	Parity error	0 to 999999
TY BER	Parity bit error rate. #PAR ERR/# bits	.1 x 10^{-9} to 9.9 x 10^{-3}
IT ERR	Frame bit errors	0 to 999999
ME BER	Frame bit error rate # FR bit ERRS/ # frames	.1 x 10^{-9} to 9.9 x 10^{-3}
OSS	Loss of frame	3 frame bit errors in 16 frames; 3 corrupted M-bit patterns in a row
-	Seconds w/lost framing	0 to 999999
ERR	Bit errors	0 to 999999
	Bit error rate	.1 x 10^{-9} to 9.9 x 10^{-3}
t PAR	C-Bit parity error	0 to 999999
t PAR	C-bit parity bit error rate # C-Bit PAR ERR/ # bits	.1 x 10^{-9} to 9.9 x 10^{-3}
FEBE	Far end block errors	0 to 999999
FEBE BER	Far end block error rate	.1 x 10^{-9} 9.9 x 10^{-3}
AIS	Alarm indication signal (1010...)	>40 ms of AIS pattern
AIS-SEC	Seconds in which the AIS pattern occurred	0 to 999999
IDLE	IDLE signal (1100...) received	
X-BIT ALARM	X-BIT alarm State of X bit is set with Dip switch S2/1	X bit indicates remote alarm for > 1 sec
X-BIT ALM-SEC	Seconds of X-BIT alarm	0 to 999999
ERR-SEC	Seconds w/ one or more errors	0 to 999999
SYNC LOSS-SEC	Seconds in which bit pattern synch is lost	0 to 999999
	DS2 DIAGNOSTICS	
LOS	Loss of signal	
FR BIT ERR	Frame bit errors	0 to 999999
FRAME BER	Frame bit error rate # FR bit ERRS/ # frames	.1 x 10^{-9} to 9.9 x 10^{-3}
FR LOSS	Loss of frame	2 frame bit errors in 5 frames; 2 corrupted M-bit patterns in a row
FR L-SEC	Seconds w/lost framing	0 to 999999
X-BIT ALARM	X-BIT alarm State of X bit is 0	X-BIT alarm for > 1 sec
X-BIT ALM-SEC	Seconds of remote alarm	0 to 999999

4-1. Measurement definitions, ranges and criteria (Cont.)

surement	Definition	Range/Criteria
	Alarm indication signal (1111...)	> 100 ms of all 1's pattern
SEC	Seconds in which the all 1's pattern occurred	0 to 999999
SEC	Seconds w/ one or more errors	0 to 999999
	DS1 DIAGNOSTICS	
	Loss of signal	
IT ERR	Frame bit errors	0 to 999999
ME BER	Frame bit error rate # FR bit ERRS/ # frames	.1 x 10^{-9} to 9.9 x 10^{-3}
OSS	Loss of frame	2 frame bit errors in 5 frames
-	Seconds w/lost framing	0 to 999999
-COUNT	absolute # of slipped bits/193	0 to 999999
ERR	CRC-6 errors	0 to 999999
BER	CRC-6 bit error rate # CRC-6 ERRs/# bits	.1 x 10^{-9} to 9.9 x 10^{-3}
ALARM	Yellow alarm SF/SLC-96	bit 2 in each channel = 0 for 30 ms.
	ESF	14 consecutive sequences of eight 1's followed by eight 0's
ALM-	Seconds in which the yellow alarm occurred	0 to 999999
	Alarm indication signal (1111...)	> 100 ms of all 1's pattern
AIS-SEC	Seconds in which the all 1's pattern occurred	0 to 999999
ERR-SEC	Seconds w/ one or more errors	0 to 999999
SEV ERR-SEC	Seconds in which one or more of the following occurred - over 320 CRC errors - over 1544 BPV's - over 12 frame bit errors - frame loss	0 to 999999
CSE-SEC	3 or more consecutive SEV ERR-SECs	0 to 999999

4.8 IN-SERVICE MONITORING APPLICATION INFORMATION

In recent years, in-service testing has become increasingly popular. This has come partly from the recognition of the measurement validity and usefulness and partly from the frequent impracticality of turning a system down to perform traditional out-of-service testing. This section discusses a number of in-service testing related issues as well as the applicability of the measurements described in the previous sections.

4.8.1 FBER vs PBER for DS3 measurements

In actual use, the readings obtained for FBER and PBER are not always identical and this could easily lead to confusion. The reading of the next paragraphs discussing the two measurement techniques may help cast some light on this matter.

The FBER gives a highly reliable measure of the actual bit error rate for the overall transmission when the error distribution is uniform. Fortunately, this is the most prevalent case in PCM transmission systems. The FBER measurement is quite precise because it rests on the highly accurate frame bit error count. One should keep in mind that frame bit errors are declared only when a frame bit is detected as having a state opposite to the expected one. One must also note that when monitoring PCM signals exhibiting a low bit error rate, (1 x 10^{-9} or less) it takes a relatively long time to acquire a

tically meaningful number of frame bit

BER measurement rests on the parity bit count. It can be shown that the acy of this measurement depends on the rate itself. At low error rate, up to about the measurement closely tracks the l bit error rate. When the error rate rises 10^{-7}, the accuracy deteriorates because arity error count is no longer accurate. can be readily understood by observing a parity error is declared only when an number of bit errors corrupt a group of bits (information bits in a DS3 frame). In turn, this means that at low rates a single error occurs from time to and it is picked-up accurately as a parity As the error rate grows worse however, ikelihood increases that two bit errors pt a single 4704 bit bundle. Yet because s an even number of errors, the parity bit t is not affected and the measured bit rate will thus be somewhat more istic than the actual one. As the error increases further the accuracy worsens use more than 2 bit errors can corrupt a rframe and only one or no parity bit error clared.

way, it is most fortunate that these two surements can be performed ltaneously by the test set as they plement each other very well. The FBER is ys perfectly accurate but requires longer longer time as the bit error rate grows ler. Conversely, the PBER is obtained in a short time but its accuracy is only ndable when the bit error rate is relatively Consequently, if the measurement is to erformed in the shortest time possible, the R yields satisfactory accuracy when the rror rate is 10^{-7} or better; the FBER on the r hand gives high accuracy and requires and less time as the bit error rate worsens n 10^{-7}.

ay be useful to point out that although n FBER and PBER methods have some tations, the combination can yield an ellent measure of the actual PCM smission system performance without upting the traffic. This is very important when considering that a single DS3 bit stream can simultaneously carry up to 672 calls.

4.8.2 DS1 In-service BER Measurement

Although BER measurement is generally thought of as an out-of-service based measurement, it is possible to obtain an excellent estimation of the true bit error rate sustained by the DS1 formatted transmission without interfering with the traffic. Three methods yielding indirect BER measurements are discussed in this section.

- CRC based BER

When monitoring ESF formatted DS1 transmission, the CRC-6 error rate yields a good approximation of the actual bit error rate when the observed rate is 10^{-6} or smaller. When the BER is significantly greater than this value, the accuracy is reduced. This results from the fact that a CRC error is declared when one OR MORE bit errors have been introduced in a field of 4632 bits (24 frame/ESF). When the error rate decreases, so does the probability that more than one bit error occurs in a block of 4632 bits, and thus one CRC error is more likely to represent one bit error. In short, the CRC BER is a dependable BER measurement when the CRC BER is 10^{-6} or smaller. The main shortfall of this measurement is that it only applies to ESF formatted DS1 transmission.

- Frame bit based BER

The computation of the FRAME BER by the 160A yields a very good estimate of the true BER and is applicable to both SF and ESF formatted DS1 bit streams. The main disadvantage of this technique is that it requires typically a long test time when the BER is small (1×10^{-8} or less). The usability of the FRAME BER to characterize the entire bit stream rests on the observation that PCM transmission corrupts every bit with the same probability. As a consequence, the bit error rate computed for one bit is statistically the same as for all the other bits if the test period is sufficient. The required test period depends on the desired accuracy of the measurement and of the BER itself since a minimum number of errors must be observed to obtain a meaningful measurement. To help in determining the minimum required period of monitoring,

o the graph in figure 4-1. The graph is on the minimum time required to e 4 frame bit errors as a function of the pated BER for both SF and ESF tted transmission.

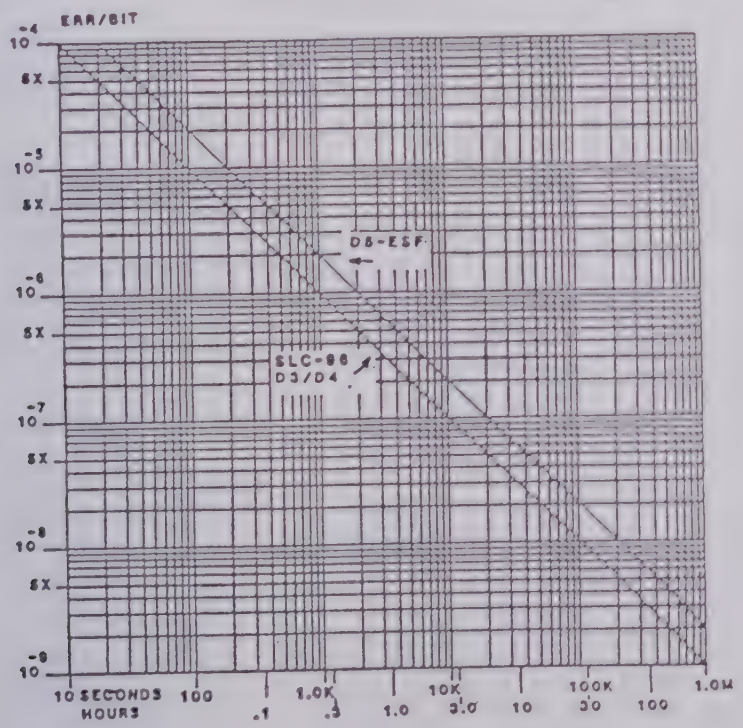
uld be noted that the values obtained this chart are only the minimum, and verall measurement accuracy is always sed by exceeding the given values.

se the graph in figure 4-1, select the ted BER on the vertical axis and extend prizontal line to the slanted line sponding to the transmission format Mark the intersection with a dot. A line n vertically from the dot to the horizontal ields the minimum needed test time.

xample, if a D3/D4 system is expected hibit an average bit error rate of $5x10^{-7}$ s/bit, the minimum required observation is approximately 2000 seconds (just 1/2 hour).

4.8.3 Impairment Data Recording

When the 160A is equipped with Option 02, a time and date stamped record of the impairment activity monitored by the 160A can be obtained. Additional information on the use of this capability is provided in Chapter 7.



ire 4-1 Minimum Required Test Time

TER 5
THE DS3 TRANSMIT CAPABILITIES

INTRODUCTION

0A DS3 Transmit section can generate number of framed and unframed test ss and inject many transmission ments These capabilities are most for testing and characterizing a ission facility prior to its placement in and for maintaining transmission ment on an out-of-service basis. This r describes how to use all the DS3 nit section capabilities. The chapter is d in five main sections:

nerating DS3 test patterns
nerating the X-bit alarm
cting impairments
RU mode operation
1 Drop & Insert

GENERATING DS3 TEST PATTERNS

S3 test pattern you require is generally d by four parameters:

ture of the pattern
pe of framing (if any)
ck source and
tput level

60A allows you to select individually all parameters as well as to introduce nission impairments and X-bit alarm in elivered bit stream. This section covers hese items with the exception of rment injection and X-bit alarm mission; these topics are covered in ns 5.3 and 5.4.

DS3 PATTERN SELECTION

pressing the TEST PATT key in the DS3 mit section, screen [1] is displayed by FDT.

n [1]

```
3  2^20  2^23  CODE
1  1010  1100  FR UFR
```

(softkeys)
#1 #2 #3

By using the right (▸) or left (◂) pointing keys, the pattern underline can be moved to the adjacent selection. The underline at the UFR or FR selections is shifted by depressing softkeys #1 or #2. The DS3 Transmit section delivers the current selection at the T3 output. For example, if 1/1 and FR are underlined, as shown in screen [1], the signal present at the DS3 output is the framed all 1's signal.

The 2^{15}, 2^{20} and 2^{23} are quasi-random bit pattern sequences in common use. The framed 1010 pattern, AIS, is the Alarm Indication Signal of alternating ones and zeros. DS3 Idle code is indicated by the framed 1100 pattern which is the 11001100... bit series.

Depressing the EDIT key when the CODE selection is underlined causes the VFDT to display a screen similar to screen [2].

Screen [2]

```
CODE: 101100__
          UFR FR BLNK
```

(softkeys)
#1 #2 #3

Screen [2] represents a string of 7 bits previously stored in the battery backed memory. The DS3 transmitter delivers this bit sequence over and over starting from the left-most bit and ending with the right-most bit. If softkey #2 header, FR, is underlined, this stream is framed. Depressing softkey #1 causes the UFR header to be underlined and the bit stream to be unframed.

You can edit screen [2] to create any arbitrary bit pattern from 1 to 8 bits. The screen shows solid underlines for bits that are not being used; the flashing underline acts as a cursor. The left and right arrow keys are used for moving the cursor to the desired bit position in the string. You use the 1 and 0 keys above the cursor keys to define the state of each bit in the desired pattern. To add a bit to the pattern, enter a 1 or 0 in the position after the right-most bit.

key #3 (BLNK) allows you to shorten the th of the pattern. Depressing this key es the bit at the cursor and all the bits ediately to its right (if any) to be blanked-

current DS3 selection can be overridden bit stream is externally supplied to J13, DS1 IN jack located on the right side l. While the signal supplied to this jack is patible with the interface requirements the TEST PATT key is in the FLOSO e, the VFDT displays screen [3]. Details S1 insertion are given in section 5.6.

en [3]

```
1 Group 01 in DS3
. now = AUX DS1 IN
```

2 FRAMING AND CLOCK SOURCE

FRAME & CLK SRC menu allows you to ct the framing format for the pattern vered by the DS3 transmitter. It also vides for selecting the clock source. ressing the FRAME & CLK SRC key ses the LED in this key to take the FLOSO e and the VFDT to display a screen similar creen [4].

een [4]

```
XMT FRAMING
        C-BIT      M13
```

(softkeys)
#1 #2 #3

s screen allows you to select either the 3 or C-BIT Parity framing format. The lerline can be changed to C-BIT by ressing either pointer key. The framing ection is only effective when the DS3 nsmit section delivers an internally erated, framed pattern. The framing of a nal applied to the diagnostics receiver ile the 160A is in thru mode may not be dified by the DS3 transmitter.

e green ALT SEL key will be lit indicating additional menu associated with the AME & CLK SRC key. When this is ssed, screen [5] is displayed.

Screen [5]

```
Clock Source
        RCVR INT
```

(softkeys)
#1 #2 #3

When screen [5] is displayed, you can select the clock source used by the DS3 transmitter. If the transmitter must use its master clock, the INT header must be underlined. Alternatively, the transmitter can use the clock recovered from the bit stream applied to the DS3 Diagnostics section by selecting RCVR.

Note:
When the RCVR clock is selected, and the receiver experiences a loss of signal (LOS) (i.e. the patchcord is removed), the 160A automatically switches the clock source to INTERNAL. The CLK SRC screen will still indicate RCVR clock selection indicating that the 160A will switch back to the RCVR clock selection once the input signal is detected again.

5.2.4 OUTPUT LEVEL SELECTION

The level of the DS3 bit stream at the OUTPUT T3 jack can be set to DSX, HI, or LO with the 3-position OUTPUT LEVEL rocker switch. The HI level output provides approximately a .9 V base to peak signal as found at the output of DS3 transmission equipment before it enters any cable. The DSX selection delivers an output with the approximate level found at a DS3 cross connect panel (.5 V b-p). This is equivilent to a HI level signal which was passed through 450 ft. of 728A cable. The LO level setting produces an output that is 13.8 dB below the HI level signal (approximately 0.2 V b-p).

When terminated with a 75 Ohm resistive load, the signal at the OUTPUT MON jack is approximately 20 dB below that at the OUTPUT T1 jack

5.3 SENDING THE X-BIT ALARM

When the DS3 Transmit section delivers an internally generated framed bit stream, X-bit alarm can be inserted in this stream. The alarm is inserted while the X-BIT ALARM key is lit. Repeated depressions of this key cause the LED inside this key to toggle on and off.

-bit alarm code is conveyed by the state X bit. The desired state for indicating alarm, X=1 or X=0, may be selected ting Dip Switch S2/1 on the side panel.

(-bit alarm can not be sent when the is in THRU mode or is injecting errors ne T3 output.

SIMULATING ERRORS

the ERROR INSERT key in the DS3 mit section is depressed, the VFDT ys the impairment menu. Some of the tions of this menu may be blanked-out ey may not apply to the type of pattern generated by the 160A. The full menu own as screen [6] if the M13 parity t is selected.

en [6]

```
Z  BIT   FRAME   PAR
10^-5     GO  1X RATE
```

#1 #2 #3 (softkeys)

e framing selection is C-BIT parity, the ALT SEL key will light indicating an ional screen associated with the ERROR RT key. Depressing it reveals screen which displays two additional impairment tions, C-BIT parity and Far End Block s.

en [6a]

```
-PAR  FEBE
10^-5     GO  1X RATE
```

#1 #2 #3 (softkeys)

BPV selection in screen [6] allows the duction of bipolar violations (or Code s). The BIT selection allows the duction of bit errors. The FRAME ction allows the introduction of F frame rrors; this selection applies only when the cted bit pattern is framed. The PAR ction lets you inroduce introduction of P- arity errors; again this selection is valid if the selected bit pattern is framed.

impairment choices in screen [6a] are valid for the C-BIT parity framing format. cting C-PAR, by pressing the arrow keys C-PAR is underlined, allows C-BIT parity (C_p bit) errors to be injected into the T3 output. Underlining FEBE permits the introduction of far end block errors into the output bit stream.

The current selection is always underlined. To activate the selection you may either depress softkey #2 (1X) to inject a single error per depression or depress softkey #1 (GO) to introduce the errors at the rate listed in the lower left hand corner of the screen ($1x10^{-5}$). While the impairment is being introduced at the specified rate, the header for softkey #1 is replaced by the flashing STOP header and the underline for the active selection flashes on and off. To stop the error injection depress softkey #1.

To change the error injection rate, depress softkey #3; this causes the VFDT to display a screen similar to screen [7].

Screen [7]

```
ERROR     1x10^-5
RATE      UP  DN ENTR
```

#1 #2 #3 (softkeys)

Both the mantissa (1) and the exponent (5) can be changed by moving the underline as required using either pointer key and pressing the UP or DN softkeys to increment or decrement these values. The error rate can be set in the range $1x10^{-9}$ (1 error in 10^9 bits) to $9x10^{-3}$ (9 errors in 1000 bits) errors per bit. By depressing the ENTR softkey, screen [6] is displayed anew with the updated rate.

5.5 THRU MODE OPERATION

When the DS3 transmitter is placed in the THRU mode, the T3 output stream is a replica of the DS3 signal applied to the DS3 DIAGNOSTIC section. Entry into THRU mode is accomplished by pressing the THRU key. The THRU mode prevails when the THRU key is in the FLOSO state. The VFDT then displays screen [8].

Screen [8]

```
DS1 group selection
          EN'D   DIS'D
```

If you select EN'D, the DS1 signal applied to the DS1 IN jack will be inserted onto the DS1

selected in the DS1 DIAG/SEL . Details of DS1 insertion are given in t section.

he THRU mode prevails, an electronic k prevents the entry of any selection ould result in traffic disruption. Exiting HRU mode first requires the depression THRU key and, within 1.5 seconds, the ession of the TEST PATT key.

DS1 DROP & INSERT

are two modes in which the 160A can ed while inserting a DS1. In normal tion, a DS1 may be inserted onto the T3 t of the transmitter. This is done on an -service basis. When the 160A is used THRU mode, a DS1 may be dropped f the received DS3, and an externally ed DS1 may be inserted. This may be on an in-service basis. Keep in mind service will be interrupted for a brief d. The two cases are described below.

Inserting A DS1

160A can act as an M13 Multiplexer by g an externally supplied T1 signal and plexing it up to any one of the twenty DS1 groups of the T3 output. This is by simply inserting a 0.0 dBDSX DS1 bit m into the DS1 IN jack (J13) on the A side panel. The test set automatically uxes the signal to the DS2 rate and in multiplexes this DS2 signal up to the rate. By selecting the desired digroup ber on the DS1 group selector, the DS1's tion in the DS3 can be controlled.

n a DS1 signal is inserted into the DS1 IN , and the 160A is not in THRU mode, the r 3 DS1s in the DS2 group each contain all ones pattern. The remaining 6 DS2s unframed and contain all ones. When the A is in THRU mode, the remaining 27 s are left intact.

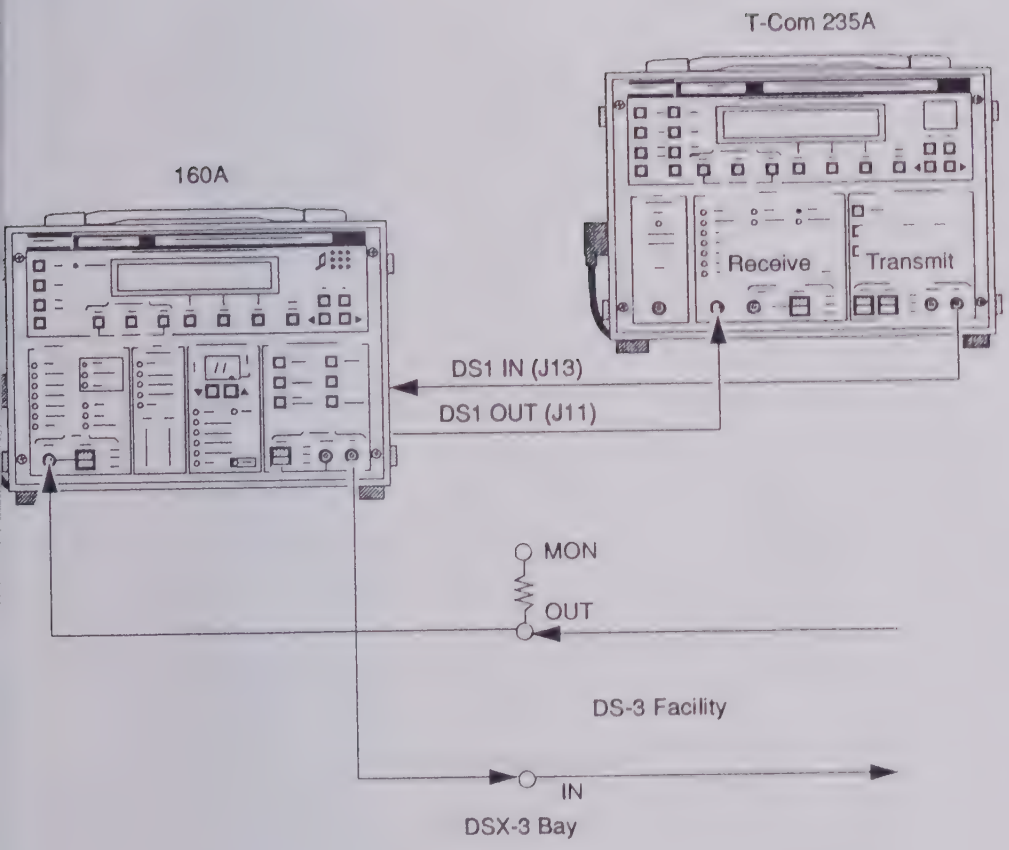
4.2 THRU mode DS1 Drop & Insert

perform DS1 drop and insert testing, the A's DS1 IN and OUT jacks must first be nected to a DS1 test set such as the T-M 235A (see figure 5.1). Follow the owing steps and take the following caution to carry out drop & insert testing.

CAUTION:
When performing DS1 Drop & Insert testing, service is disrupted. Keep in mind that a DS3 contains 28 DS1s which in turn contain 24 channels, therefore disrupting one DS3 could make 672 customers very angry. The procedure below will cause minimum disruption and assumes that you have DS3 Switching Jacks.

1. Connect the T1 test set to the DS1 IN and DS1 out jacks as shown in figure 5-1, and set up the 235A to transmit the desired DS1 signal to be inserted.
2. Set the 160A framing format to be compatible with the framing format of the DS3 signal at the DSX-3 IN and OUT jacks associated with the DS3 facility under test.
3. Select the DS1 group in the DS1 DIAG/SEL section for the desired DS1 to be dropped and inserted.
4. Patch the 160A PCM INPUT to the DSX-3 MON jack of the appropriate DS3 facility.
5. Depress the THRU key. The T3 OUTPUT signal is now equal to the 160As input DS3 bit stream. The THRU key should now be lit.
6. Patch the T3 OUTPUT of the 160A to the DSX-3 input A or ALT jack. This bypasses the cross connect. The only interruption occurs during the time when the connector is inserted into the jack.
7. Depress the EN'D softkey to drop out the selected DS1 digroup and insert the DS1 which is inserted in the DS1 IN jack of the 160A.
8. After it is established that the DS1 group is successfully passed through to the 160A, a timed test may be run to ensure long term stability.
9. The above procedure may be repeated for each of the twenty eight DS1s.

At this point you know all that is important to know about the 160A DS3 Transmit capabilities.



re 5-1 DS1 Drop & Insert

PTER 6
RMING OUT-OF-SERVICE TESTS

INTRODUCTION

ut-of-service testing capability provided he 160A is primarily intended to acterize the transmission integrity of a ity. This instrument includes a number of res to perform:

t error rate testing to qualify DS3 cilities
13 multiplexer acceptance testing
acility testing of the signal path through -3 and 3-1 electronic cross connect ystems

is chapter, you will find test set-up and cation information for all these features well as general information about the iples of OOS tests.

void repeating set-up information, you are red to chapter 4 for setting up DS3 toring, and chapter 5 for DS3 pattern ration.

OUT-OF-SERVICE TESTING PRINCIPLES

orming the tests described in this chapter a transmission facility while it is placed of-service yields dependable and quick lts. The purpose of these tests is to racterize the suitability of any facility to y PCM traffic. To this end, the facility smission performance is primarily uated under various conditions simulating traffic. Other tests may be used for fying the integrity of terminal equipment h as DS3/DS1 digital cross connect tems (DCS 3/1) or M13 multiplexers.

purpose of this section is to discuss the ciples on which these tests are based. se tests may be performed either in a ight-away basis as illustrated in figure , or they can be carried out in a looped de by looping the far end of the facility ure 6.2.

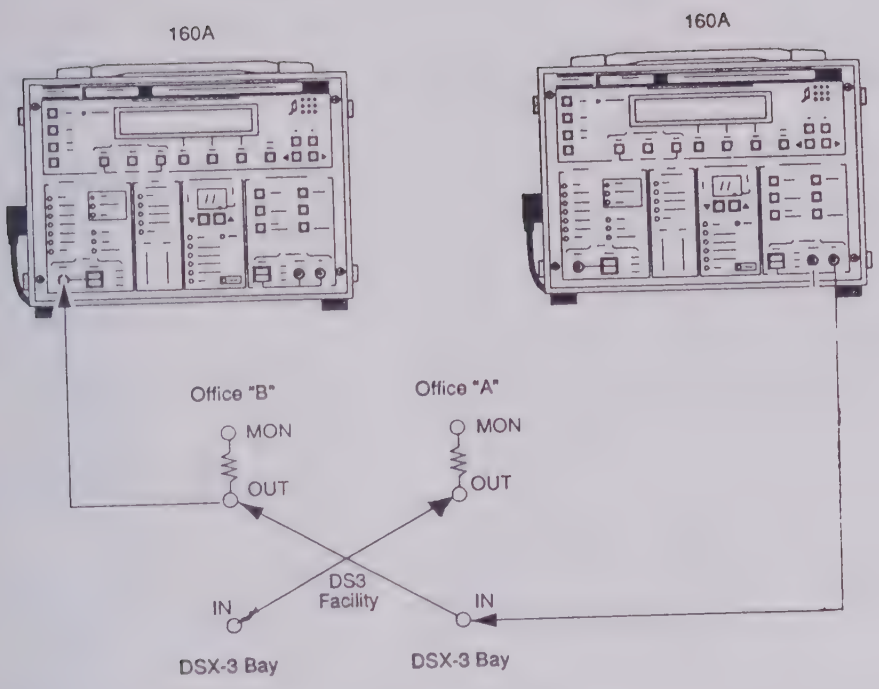
Since the 160A combines a transmitter with a receiver, looped tests can be performed using a single instrument.

Bit Error Detection
Regardless of the testing configuration, the DS3 monitor circuit detects errors by comparing on a bit-by-bit basis the monitored pattern with an exact copy of the signal delivered by the sender to the facility. This copy is created by a generator similar to the one used by the sender. This generator is synchronized with the monitored pattern to ensure proper phase relationship since an exact phase relationship is required to obtain a meaningful bit-by-bit comparison.

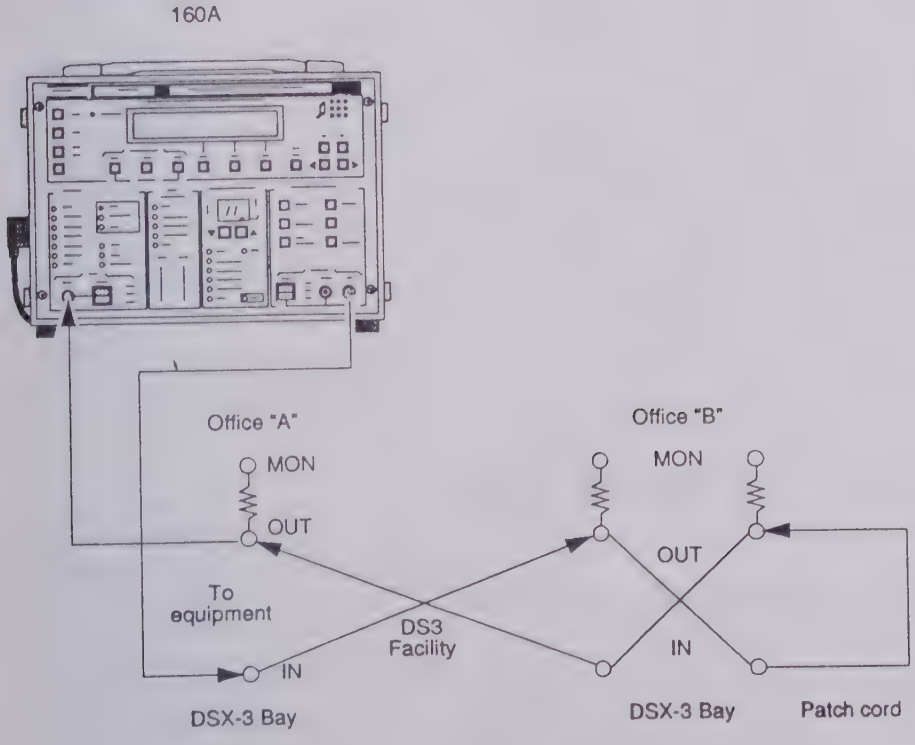
Upon achieving pattern synchronization, bit errors are detected and accumulated. They may be processed further to yield errored seconds, average bit error rate (BER), as well as other accepted characterizations.

The measurement of the average bit error rate (BER) is obtained by calculating the ratio of the total number of bit errors detected to the total number of bits transmitted. This second number is obtained from the product of the nominal bit rate (44,736,000 bits/sec) by the number of seconds synchronized since the last test began.

Typical patterns used to simulate traffic consist of relatively random bit sequences. These sequences are generally referred to as quasi-random or pseudo-random because they have a finite length and must be repeated over time. Consequently, unlike real traffic, they are not truly random. Examples of such patterns are given in table 6-1.



ure 6-1 **Straight Away Test Configuration**



gure 6-2 **Looped Test Configuration**

6-1 Commonly used PRBS test patterns

Length	Comment
32,767	14 consecutive zeros maximum
1,048,575	19 consecutive zeros maximum
8,388,607	22 consecutive zeros maximum

160A OUT-OF-SERVICE TESTING CAPABILITIES

out-of-service test pattern sending pility is associated with the DS3 smit section of the 160A. This section enerate all the test patterns described in receding paragraphs and some additional patterns as well : a 1 to 8-bit user-ed stress pattern, an all 1s pattern, Idle and the DS3 Blue Signal (AIS). ermore, the DS3 Transmit section has a sion for injecting various impairments in elivered bit streams.

bit monitoring capability is provided lusively by the DS3 Diagnostic Receiver of 160A. With the 160A's auto search re turned off, the receiver compares the tored bit stream with the pattern ted in the transmitter. When the 160A's search is enabled, the receiver searches gh all the patterns that the transmitter send until it finds a match. Once the ver is synchronized to a pattern while search is turned on, it will not search for her pattern unless a RESET command is n.

DS3 Diagnostics Receiver displays in real the pattern synchronization (SYNCH) and occurrence of a transmission impairment as bit error, code error, etc. as noted in 4-1 (page 4-10). Bit errors can be cted only while pattern synchronization ails. A microcontroller processes the counts and yields errored seconds as as error rates.

lly, the built-in test timer allows you to ct a test duration of up to 1000 hours with a resolution of one second, or to run a test without a time limit.

6.4 SETTING-UP THE 160A FOR OUT-OF-SERVICE TESTING

To perform out-of-service testing, you can use the 160A to send test patterns, to monitor them or to perform both functions at the same time. Figure 6-2 shows the typical test set-up applicable to all the procedures given below.

The OUTPUT T3 jack of the 160A is patched to the XMT side of the facility, the facility is looped at the far end with a patch cord, and the RCV side of the facility is patched to the INPUT PCM jack of the analyzer.

To set the correct input settings on the DS3 DIAGNOSTIC PCM input jack and the DS3 TRANSMIT T3 output jack, refer to figure 6-3 below. This figure illustrates typical access points for performing DS3 testing at both the DSX-3 jack field and at DS3 terminal equipment.

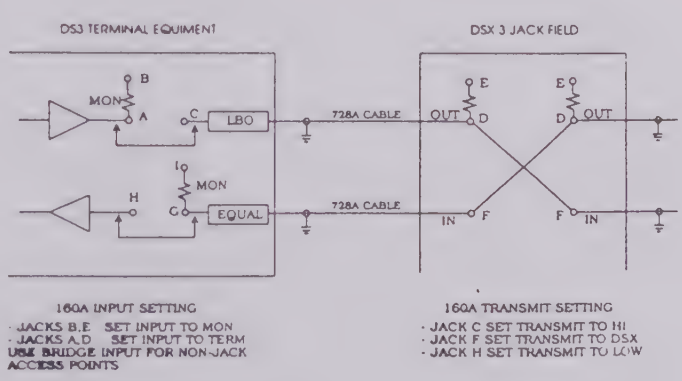


Figure 6-3 DS3 Measurement Points

To obtain a printed record of the result of each test the 160A must be equipped with option 02 and a compatible printer must be connected to the RS-232-C Port. Chapter 7 in this manual provides additional information with respect to the RS-232-C port.

GENERAL TEST PROCEDURES FOR OUT-OF-SERVICE TESTING

t of general procedures for setting up the A to test a facility is given below.

1 Setting the Test Time

Access the TEST TIME menu and if the imit is to be changed, depress the SET oft key.
Set the desired test time using the UP and DN softkeys and depress the GO softkey o store the value (this also initiates the est sequence).

2 Sending a Test Pattern

Set the output level as appropriate (DSX if patched at the DSX bay). (See fig. 6-3)
Select the clock source from the FRAME & CLK SRC menu.
Select the desired test pattern from the TEST PATT menu.
Select the framing format (if the test pattern is framed) using the FRAME & CLK SRC menu.

.3 Injecting Impairments

Select the type of error from the ERROR INJECT menu.
Select the error rate from the RATE sub-menu if applicable.
Depress the 1X softkey to introduce single errors or the GO softkey to inject the impairment at the selected rate.

5.4 Monitoring the Bit Stream

Set the input level selection SEL as appropriate. (See fig. 6-3)
Reset the test set to clear the counters, initiate the start of the test timer and acquire pattern synchronization.
Read out the DS3, DS2, and DS1 impairment statistics using the CNT, SEC and BER menus.

5.5 Observing Slippage

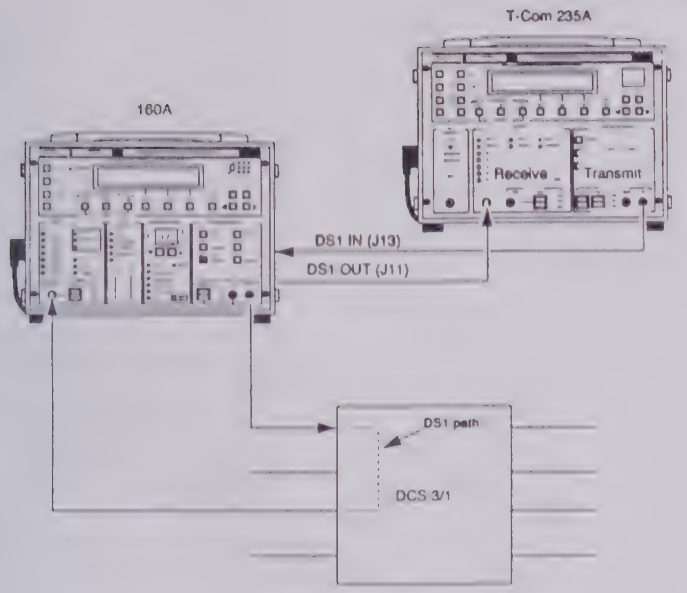
Access the slippage screen by depressing the DS1 STATISTICS key and the CNT softkey.

6.6 OUT-OF-SERVICE TESTING APPLICATIONS

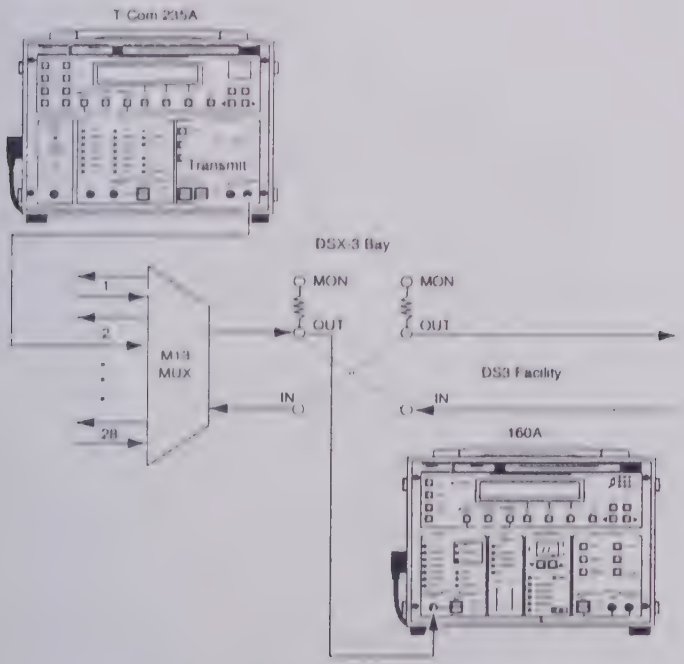
The 160A has the ability to drop out a DS1 digroup from the DS3 input signal as well as to insert an externally supplied DS1 onto a selected digroup in the T3 output. A T1 level test set such as the T-COM 235A may be used to generate a DS1 signal for DS3 up-muxing by the 160A. The 235A T1 Transmission Analyzer may also be used to supplement the 160A's DS1 diagnostic capabilities in qualifying the selected T1 bit stream. There are numerous applications for using the 160A's multiplexing and demultiplexing capabilities. Two fairly common ones are discussed below.

DS3/DS1 Cross-connect System (DCS 3/1) Test
The DS1 signal path through a DCS 3/1 may be tested by using the 160A and a DS1 level test set such as the 235A. Follow the procedure below and see figure 6-4 for set-up.

1. Set the 160A framing format to be compatible with the framing format of the DCS 3/1 ports being tested.
2. Select the DS1 group in the DS1 DIAG/SEL section for the proper DS1 path to be tested.
3. Patch the 160A T3 output and PCM INPUT to the DSX-3 IN and OUT jacks of the DCS 3/1 to be tested.
4. Patch the 235A (or equivalent) T1 Input and output to the DS1 OUT (J11) and IN (J13) Jacks on the right side panel of the 160A.
5. Set up the 235A to transmit QRS pattern and push the RESET keys.
6. Verify the 235A receiver is synched on the same pattern. (It is suggested to insert errors onto the DS1 output of the 235A and verify receipt of the same errors at the 235A receiver.)
7. To measure the performance of the DCS 3/1 DS1 path simply set the test timer to run for a desired length of time.



ure 6-4 DCS 3/1 Path Test Configuration



ure 6-5 M13 Mux Test Configuration

Multiplexer Test

M13 Mux may be tested with the 160A to y proper operation. Either the plexing or the demultiplexing capability ne M13 Mux may be tested with the A and a DS1 signal source. The edure for qualifying the multiplexing ess is illustrated by figure 6-5 and is ribed below. Again the T-COM 235A is vn as the DS1 signal source.

Set the 160A framing format to be compatible with the framing format of the DS3 signal at the DSX-3 IN and OUT jacks associated with the M13 Mux under test.
Select the DS1 group in the DS1 DIAG/SEL section for the desired DS1 to be tested.
Patch the 160A PCM INPUT to the DSX-3 OUT jack from the multiplexer.
Patch the 235A (or equivalent) T1 OUTPUT jack to the input jack on the DS1 side of the M13 Mux. This should be the same DS1 group as selected on the 160A.
Set up the 235A to transmit QRS pattern.
Inject frame bit or CRC errors into the bit stream at a known rate.(i.e. 9×10^{-5})
Verify the 160A is receiving and demultiplexing the same pattern by verifying receipt of the DS1 signal with corresponding errors at the transmitted error rate (i.e. 9×10^{-5}).
After it is established that the DS1 group is successfully passed through to the 160A, a timed test may be run to ensure long term stability.
The above procedure may be repeated for each of the twenty eight DS1 inputs to the Mux.

PTER 7
G THE PRINTER INTERFACE
(OPTION 02)

INTRODUCTION

n equipped with option 02 - the RS-232- erface port, the 160A can interface with nter or terminal. This capability allows the ument to down-load acquired impairment stics to produce a hard-copy printout. In chapter, you will find:

- description of RS-232-C port capabilities
- irections for using the RS-232-C interface

ie 160A is not equipped with option 02, chapter does not apply to instrument ration.

RS-232-C PORT INTERFACE CAPABILITIES

airment data obtained and processed by 160A can be transferred via the RS-232- ort to equipment compatible with the RS- 2 interface standard. This primarily udes printers and PC type terminals. The DA interfaces with this equipment via cable modem.

a output via the RS-232-C port consists of iable length ASCII character strings. This a is formatted to fit within 80 columns.

ction 8.5 in this instruction manual scribes pin assignment for RS-232-C nnector J14.

ction 3.4 describes a family of menus used set up the 160A RS-232-C port to operate th the following parameters:

DATA BITS	7 or 8
PARITY	NONE, EVEN or ODD
STOP BITS	1, 1.5 or 2
BAUD RATE	300, 1200, 2400, 4800, 9600
FLOW CONTROL	NONE, DSR, CTS XON/OFF

To select the flow control type, program the flow control function in screen [1] (below). For information on accessing this screen, refer to Chapter 3, under the section "RS-232-C Port Parameters" on page 3-7.

Screen [1]

```
FLOW CONTROL: NONE
DSR CTS XON/OFF NXT
```

#3 (softkey)

Flow control types (shown in screen [1]) are as follows:

NONE: no flow control selected

CTS: the CTS signal (J14/5) must be at state ONE (-10 V) for data to be transferred. If the CTS signal is ZERO (+10 V), flow control is exercised.

XON/XOFF: when an XON character (control-S, ASCII value 13H) is received by the 160A, flow control is exercised. Flow control continues until the XOFF character (control-Q, ASCII value 11H) is received by the 160A.

DSR: the DSR signal (J14/6) must be state ONE (-10 V) for data to be transferred. If the DSR signal is ZERO (+10 V), flow control is exercised.

> **Note:**
> Do not keep the 160A in flow control for a prolonged period or the internal data buffer will overflow, and data may be lost or corrupted.
>
> When the T-COM Thermal Printer (P/N) 1470-002) is used, set flow control to CTS. Use a straight RS-232-C cable since the 1470-002 is wired as DCE.

1 General Messages and Interface Commands

paragraph describes messages supplied the 160A and commands recognized by instrument. Commands referred to here t be supplied to the 160A from a board associated with the printer or minal connected to the RS-232-C port. If r printer lacks a keyboard, you may vate several commands from the PRNT ction in the MODE key/menu. More rmation on the PRNT selection is found in tion 3.4 of this manual.

Messages down-loaded by the 160A
When the 160A has completed power-up self-test, it delivers the following message:

T-COM 160A DS3 TRANSMISSION TEST SET
-DATE : ab/cd/ef <M/D/Y> -
-TIME:gh:ij<HH:MM>
-SELF TEST COMPLETED
-TYPE H <cr> FOR COMMAND
INFORMATION(cr = enter key)

If a fault is detected during self-test, the appropriate message denoting the nature of the fault is printed. Table 7-1 lists possible error messages.

le 7-1 Self Test Result Messages

NO SELF-TEST ERRORS DETECTED
SELF-TEST FRAME LOSS ERROR
SELF-TEST SYNC LOSS ERROR
CODE ERRORS DETECTED
BIT ERRORS DETECTED - SHOULD BE 0
FRAME BIT ERRORS DETECTED - SHOULD BE 0
PARITY ERRORS DETECTED - SHOULD BE 0
C-BIT PARITY ERRORS DETECTED- SHOULD BE 0
FEBE ERRORS DETECTED - SHOULD BE 0
PARITY ERRORS DETECTED - SHOULD HAVE BEEN 10
BIT ERRORS DETECTED - SHOULD HAVE BEEN 10
FR BIT ERRORS DETECTED - SHOULD HAVE BEEN 10
C-BIT PARITY ERRORS DETECTED - SHOULD HAVE BEEN 10
FEBE ERRORS DETECTED - SHOULD HAVE BEEN 10
DATABASE CHECKSUM ERROR FOUND - DEFAULTS RESTORED

te: Where "##" denotes actual error count. Refer to Chapter 3 for details.

the H<cr> command is received the delivers the following message:

CLEAR ALL COUNTERS AND
RESET ELAPSED TEST TIMER
SET ACTIVITY REPORT
TIME PERIOD TO ## MINUTES
(1 to 99)
PRINT SUMMARY REPORT
PRINT CURRENT RECEIVER
STATUS
PRINT SOFTWARE VERSION
PRINT SELF-TEST RESULTS
PRINT THIS MESSAGE

OTE:
YPE <CR> (ENTER KEY) AFTER
ACH COMMAND

unlisted command is entered, the 160A the following message:

OMMAND <INPUT COMMAND> NOT
OUND - H <CR> FOR HELP

e <INPUT COMMAND> was the nand that was entered.

160A receives a RESET command, all rment counters and the elapsed test are reset. The 160A then responds

HE 160A HAS BEEN RESET.

tarts sending its activity report.

#]<cr> command allows you to set the ity report period. The [##] is a number n the range 1 to 99 minutes. This nand performs the same function as the REPRT TMR screen [22] in section 3.4.

r> command causes the 160A to down- the summary report for the current test. command is the same as the SUM RT command entered from screen [20] ction 3.4. The content and format of the t are described in section 7.2.3.

r> command causes the 160A to down- a status report detailing the current state e receiver. This command is the same as the RCVR STATUS command entered from screen [21] in section 3.4. The format of this report is described in section 7.2.4.

VER<cr> command causes the 160A to down-load the software version number and release date. This command is the same as the SW command entered via screen [9] in section 3.4.

STR<cr> causes the 160A to down-load the results of power-on self-test. This report lists each error type and error counts that occurred during self-test. This command cannot be invoked using the MODE menu and is thus not available with a receive-only terminal. See Table 7-1 for possible messages.

The **LINE1 "message"<CR>** and **LINE2 "message"<CR>** commands allow the 235A power up message on the VFDT to be customized. The message is a string of up to 20 characters which must be enclosed in quotes. For example, entering the command LINE1 "I LOVE MY 235A" will cause this message to be displayed on the top line of the VFDT upon power up.

7.2.2 The Activity Report

Activity reports are automatically sent by the 160A. The first report occurs shortly after the 160A successfully executes the self-test. Each activity report contains a record of all impairment or alarm activity detected during a selected time period. This period is set by using the T [##] command described above or from the by accessing the MODE menu as described in section 3.4 of this manual.

Activity reports are test-independent; if a test stops as a result of a time-out, activity reports continue to record all events, even though all test error counters are stopped.

ivity reports reflect :

DS3

R SECOND --FR LOSS-SEC
S SECS --X-BIT ALARM SECS
BIT ERRS --C-BIT PAR ERRS
BE ERRS --BIT ERRS
NCH LOSS SECS

DS2

R-SECOND --FR LOSS-SEC
S SECS --REM ALARM SECS
BIT ERRS

DS1

--ERR-SECOND --SES
--CSES --FR LOSS-SEC
--AIS SEC --REM ALARM SECS
--FR BIT ERRS --CRC ERROR
--SLIP COUNTS

--MANUAL RESET COUNTS

After 24 lines of data are sent, the heading is re-sent preceded by 3 blank lines.

A sample activity report is shown in table 7-2.

ble 7-2 Sample Activity Report

TIVITY REPORT TE	TIME	EVENTS	DS3 COUNTS	DS2 COUNTS	DS1 COUNTS
/01/91	10:13	ERR-SEC			1
		CRC ERR			1
/01/91	10:52	C-BIT PAR ERR	120		
/01/91	10:53	FR LOSS-SEC		23	

le report shown in Table 7-2 reflects the owing conditions:

le test data recorded in table 7-2 started at :12 with patch cord plugged into the DS3 M INPUT jack. The selected time period s one minute. Consequently, a line item is nted only if one or more events occurred ring the previous minute.

tween 10:12 and 10:13, one CRC error curred; it resulted in one errored second

affic was unimpaired between 10:13 and :51.

tween 10:51 and 10:52, 120 C-bit parity rors occurred.

tween 10:52 and 10:53, the 160A lost S2 frame for 23 seconds.

7.2.3 The Activity Summary Report

As previously noted, activity summary reports are down-loaded whenever the S <cr> is sent to the printer interface port, or whenever generated from the MODE keys PRNT menu. Table 7-3 shows a sample summary report. The heading includes the current date and time, and the elapsed test time.

7-3 Sample Activity Summary Report

ACTIVITY SUMMARY

: 10/01/91 TIME 05:51
TIME : 0:01:42
ISMITTER IS IN THRU MODE

TS	DS3	DS2	DS1
IVER	LOS	LOS	LOS
TY ERRS	0		
T ERRS	0	N/A	N/A
T PAR ERR	0		
ERRS	0		
RROR	0		
CERRS			0
COUNT			0
SEC	0	0	0
OSS-SEC	0	N/A	N/A
			0
			0
SECS	0	0	0
T ALARM-SEC	0	0	
ALARM-SEC			0
C-LOSS-SEC	0		
TY BER	LOW ERROR		
ME BER	LOW ERROR	N/A	N/A
T PAR BER	LOW ERROR		
BER	LOW ERROR		
	LOW ERROR		
BER	LOW ERROR		
SUMMARY			

s:
ER calculations are computed only if the number of errors exceed .
he N/A entry occurs if pattern or frame synchronization never occurred.
hen an event count exceeds 999999, the down-loaded value is 999999.
RC AND CBER headings and values (if any) are only down-loaded if he current system selection is ESF.
-BIT parity, FEBE counts and rates are down-loaded only if the urrent system selection is C-BIT framing.

4 The Receiver Status Report

previously noted, receiver status reports sent by the 160A whenever the R <cr> mand is received via the RS-232-C port whenever generated via the MODE keys PRNT menu. The receiver status report is a snapshot of activity detected by the receiver.

Table 7-4 Receiver Status Report

```
                    RECEIVER STATUS
DATE: 10/01/91                              TIME 03:51
RECEIVER HAS LOS.
DS1 FRAME TYPE IS <M13 or C-BIT>.
DS1 FRAME TYPE IS UNFRAMED.
RECEIVER HAS NOT SYNCED.
RECEIVER HAS SYNC LOSS - PATTERN <pattern>.
RECEIVER HAS SYNC - PATTERN <pattern>.
  - IS RECEIVING DS3 AIS.
  - IS RECEIVING DS3 IDLE.
  - IS RECEIVING DS3 X-BIT ALARM.
DS2 NUMBER <which DS2> HAS DS2 LOS.
DS2 NUMBER <which DS2> HAS DS2 FRAME.
DS2 NUMBER <which DS2> HAS FRAME LOSS.
  - IS RECEIVING DS2 AIS.
  - IS RECEIVING DS2 X-BIT ALARM.
DS1 NUMBER <which> HAS DS1 LOS.
DS1 NUMBER <which> HAS DS1 FRAME - TYPE IS <ESF or D3/D4>.
  - IS RECEIVING DS1 AIS.
  - IS RECEIVING DS1 YELLOW ALARM.
  - IS RECEIVING DS1 LOOP CODE.
```

In table 7-4, all possible aspects of the receiver report are shown. Possible values for each item are shown between angle brackets (< >). The heading includes the current date and time.

7.3 USING THE RS-232-C INTERFACE PORT

To down-load transmission statistics processed by the 160A, the RS-232-C port must be patched to a terminal directly or via a modem and transmission line.

The terminal may be a

- standard line printer providing the receive-only function
- printer with a keyboard providing both send and receive function
- computer

It may be connected directly to the 160A or via a pair of modems and a telephone line.

In all cases, the terminal must be equipped with a serial RS-232-C port.

The cable connected to the 160A RS-232-C port must have a one-for-one (direct) connection if the port connects to a modem (DCE) or if the terminal emulates a modem.

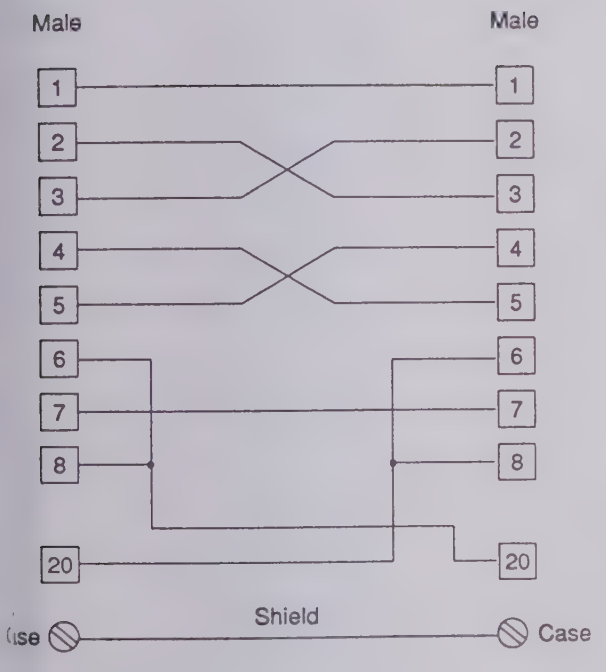
Otherwise, a null modem cable or adapter, as illustrated in figure 7-1, is used to connect to the terminal.

To ensure operational compatibility with the terminal, match the data format and flow control type selected on the 160A RS-232-C port with those of the terminal.

The data format and flow control type are selected on the 160A via the MODE key/menu as described in section 3.4 starting with screen [24]. These parameters are preserved by means of battery backup and need not be re-entered upon instrument power-up.

When the printer/terminal is properly connected, it is ready to print out reports.

inters, cables and various adapters to
ipport 160A operation can be obtained from
COM. Refer to chapter 12 for description.



igure 7-1 **Null Modem Adapter/Cable Diagram**

APTER 8
TIONS

INTRODUCTION

is chapter is in preparation and will be ailable as soon as the options for the 160A available.

APTER 9
KILIARY JACKS AND CONNECTORS

INTRODUCTION

s chapter describes the function of jacks l connectors located on the 160A right e panel. These are bantam jacks J11 and 3, and D-type connectors (J12 and J14)

ese items are illustrated in Figure 9-1.

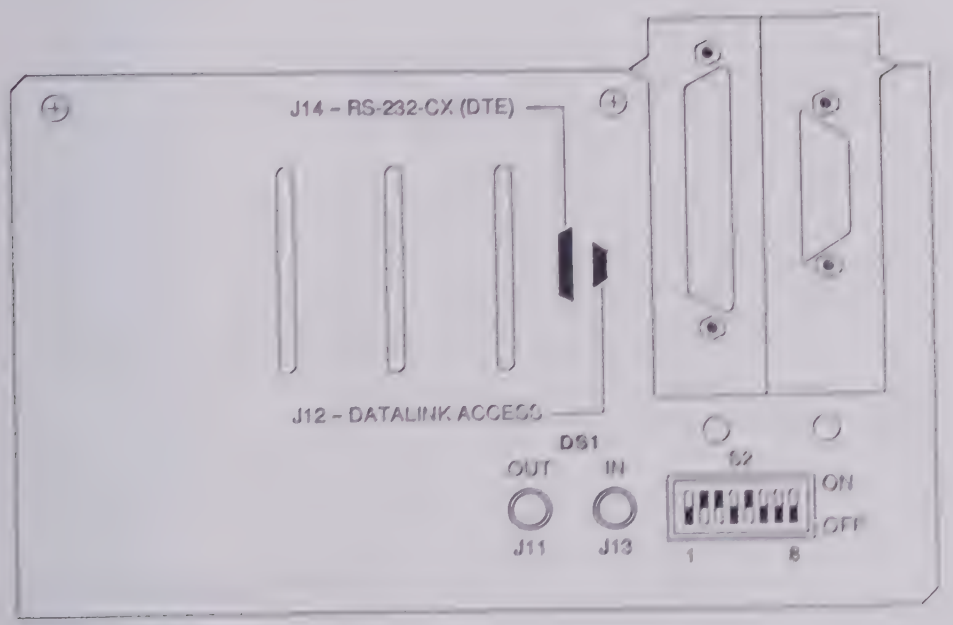


Figure 9-1 160A Auxiliary Jacks and Connectors

9.2 DS1 OUT JACK (J11)

This jack presents a buffered version of the PCM signal gained from the selected DS1 group in the DIAG/SEL section. The PCM signal present at J11 has a nominal level of 0 dBDSX when terminated into a 100 Ohm load. In effect, the 160A acts as a DS3 demultiplexer whose T1 output is J11.

9.3 DS1 IN JACK (J13)

This jack has a nominal input impedance of 100 Ohms and accepts a 0 dBDSX level T1 signal. It multiplexes this signal onto the DS3 transmitter output. The DS1 group selected (using the DS1 DIAG/SEL keys) determines the DS1 digroup onto which the auxiliary input is multiplexed.

DATA LINK ACCESS (J12)

This 9 pin D-type connector affords access to the C-BIT parity data link and clocking. The control bit clock is a 526 KHz signal and the control bit synchronization is a 9.398 KHz signal. These signals are provided for any application for which the 160A user may have a need. Figure 9-2 illustrates this connector, and identifies each pin and its function.

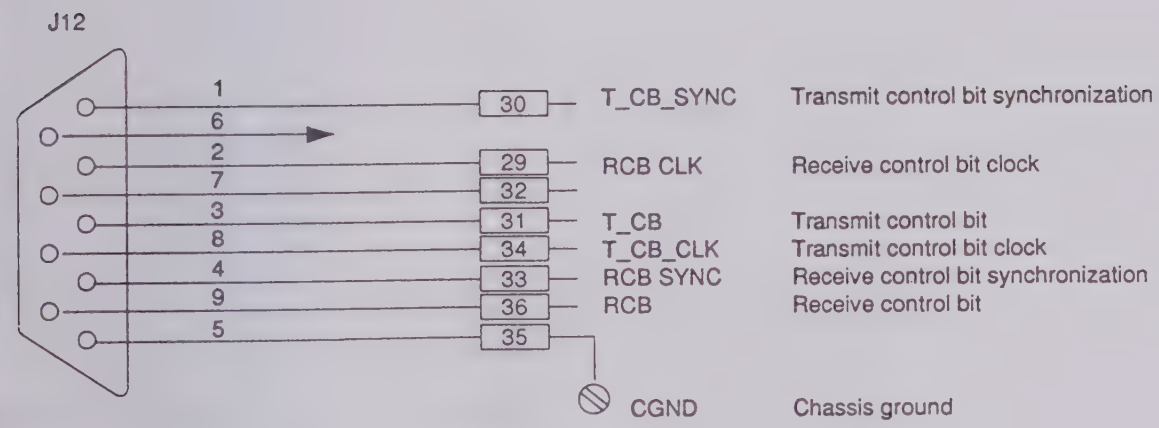


Figure 9-2 J12 Connector Pin Assignments

9.5 RS-232-C PORT (J14) (DTE)

J14 is operative only if the optional RS-232 interface port (option 02) installed. This 25 pin D-type connector serves as a communication port with RS-232-C compatible printers and terminals

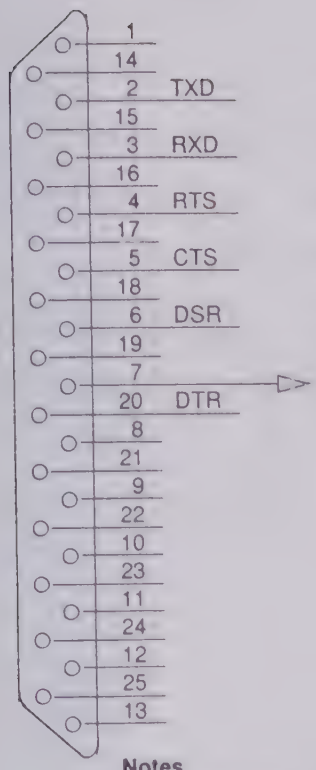
The RS-232-C port is wired as DTE. Connect this port to the output device using the following cable types:

- for most printers, use a null modem cable
- for a modem, use a plain, one-for-one cable

The logic states for these signals is as listed below:

logic state '0' => +10 Volts nominal
logic state '1' => -10 Volts nominal

J14 is illustrated in Figure 9-3. This figure also lists pin assignments and identifies signal functions. Additional information concerning the use of the RS-232-C port is given in chapter 7.



TransmittedData (output)

Received Data (input)

Request to Send (output)

Clear to Send (input)

Data Set Ready (input)

Signal Ground

Data Terminal Ready (output)

Notes

Logic states are: 0 (+10 Volts) 1 (−10 Volts) (Volts nominal)

All unlabeled lines are unused.

igure 9-3 J14 Connector Pin Assignments

CHAPTER 10
SPECIFICATIONS

DS3 Diagnostics

DS3 Input

Impedance:	Nominal 75 ohm unbalanced
Rate:	44.736 Mbits/s ± 1 kbit/s
Code:	B3ZS
Framing detect:	M13, C-bit or unframed

Measurements

Frame type	Error type
M13:	Bit, code, parity, F-bit
C-bit parity:	Bit, code, C-bit parity, parity, FEBE, F-bit
Unframed:	Bit, code

Statistics	Range
Error count:	0 to 999999
Error seconds:	0 to 999999
Error rate:	10^{-3} to 10^{-9}

Frame Type	Front Panel LED
M13 and C-bit:	Loss of signal, code error, parity error, frame bit error, frame loss, sync, alarm indication signal, idle, X-bit alarm
C-bit only:	C-bit format detected, C-bit parity error, FEBE

DS2 Diagnostics

Measurements

Error type:	Parity, F-bit

Statistics	Range
Error count:	0 to 999999
Error seconds:	0 to 999999
Error rate:	10^{-3} to 10^{-9}

Status Indicators

LEDs:	Loss of signal, frame bit error, frame loss, X-bit alarm, alarm indication signal

DS1 Diagnostics

DS1 Output

Impedance:	Nominal 100 ohm balanced
Connector:	Bantam
Code:	B8ZS or AMI

DS1 Diagnostics (continued)

Measurements

Frame Type	Error Type
ESF:	CRC-6, F-bit
D4/SLC-96:	F-bit

Statistics	Range
Error Count:	0 to 999999
Error Seconds:	0 to 999999
Error Rate:	10^{-3} to 10^{-9}

Status Indicators

LEDs:	Loss of signal, reference, frame bit error, CRC error, frame loss, yellow alarm, alarm indication signal, ESF

DS3 Transmit

DS3 Output

Impedance:	Nominal 75 ohm unbalanced
Rate:	44.736 Mbits/s ± 20 ppm
Clock select:	Internal or loop-timed
Code:	B3ZS
Patterns:	PRBS (2^{15}-1, 2^{20}-1, 2^{23}-1) Fixed (1111... 1010... 1100...) User-defined; 1 to 8 bits
X-bit:	Two state selectable
MUX mode:	Externally supplied DS1 inserted into selected digroup
Error injection:	Bit, code, frame bit, parity, C-bit parity and far end block error
Error rate:	10^{-9} to $9x10^{-3}$

RS-232-C Interface Port (Option 02)

Access:	25 pin D-sub female
Baud Rate:	300-9600

Miscellaneous

AC Power:	108 to 126 VAC, 15W
Operating Temperature:	-20 to 50° C
Humidity:	Up to 90% non-condensing

Physical

Dimensions	
Height:	7"
Width:	10"
Depth:	6" without front cover (front cover adds 1-1/2" to the depth)
Weight:	9-1/2 lbs. with detachable front cover, power cable and instruction manual

CHAPTER 11
FIELD MAINTENANCE AND CALIBRATION

11.1 INTRODUCTION

This chapter provides procedures for carrying out routine maintenance as well as the recommended annual calibration of the 160A. These procedures can be carried out by any competent electronics technician; only standard test equipment and tools are required.

11.2 ROUTINE MAINTENANCE

The only routine maintenance recommended in the field is periodic inspection and cleaning of the unit. The maintenance interval should be adjusted based on the condition and usage of the unit.

CAUTION
BEFORE PERFORMING ROUTINE MAINTENANCE, DISCONNECT THE 160A FROM AC LINE POWER AND TURN ITS POWER SWITCH TO OFF.

1. Inspect all external cords for frayed and broken insulation, particularly at connector terminations.

2. Inspect all connectors on external cords and the exterior of the unit for bent, loose, or missing pins.

3. Inspect the exterior of the unit for missing or loose screws. Replace any missing screws.

4. Dampen a clean, lint-free cloth in a solution of mild soap and warm water and wipe down all of the exterior surfaces of the unit. Allow the unit to dry thoroughly before connecting any cords or turning power on.

11.3 CALIBRATION OVERVIEW

There are five adjustments to the 160A that can be performed in the field. All of the adjustments and test points can be accessed by simply removing the bottom enclosure of the 160A. The four clocks to be adjusted are at standard TTL levels, 0 and +5V.

The adjustments are:

Real Time Clock Frequency - The RTC oscillator drives the internal clock and calendar of the 160A. This frequency can be set very accurately (approximately 1 part in 10^6) so that any noticeable short-term drift of the RTC can be compensated for.

XMT Clock Frequency - The XMT Clock is at 44.736 MHz and is used to time the OUTPUT T3 bit stream from the transmitter when selected at the VFDT. It can be adjusted to approximately 1 part in 10^6.

RCV Clock Frequency - The RCV Clock oscillator locks to and tracks the frequency of the INPUT PCM stream to the diagnostics receiver and times the internal bit patterns of the receiver. Problems with synching to the input bit pattern may signal the need for this adjustment.

Observe the following safety precautions when making the adjustments.

WARNING: Contact with voltages within the 160A can cause serious injury. Never reach inside the unit with power on. Never work alone. Always have someone nearby who is familiar with current first aid procedures for electrical shock.

CAUTION: Always wear a grounded, conductive wrist-strap when handling printed circuit boards. Static electricity can destroy firm ware and damage sensitive components.

CAUTION: Always turn power off to the unit when connecting and disconnecting test equipment leads to it. Ensure that all test equipment is properly grounded.

1.4 EQUIPMENT REQUIRED

Table 11-1 lists the tools and test equipment required for making the adjustments. Substitute test equipment may be used provided their accuracy is ten times greater than the tolerances specified for each adjustment.

Table 11-1 Tools and Test Equipment

Item	Recommended Model	Qty
Frequency Counter	HP 5314A Universal Counter	1
Oscilloscope	Tektronix 2215A	1
Voltmeter	HP 3468A/B Digital Multimeter	1
T3 Signal Source		1
Screwdriver	Medium-sized Philips head	1
Screwdriver	Small slotted-tip	1

11.5 ACCESSING THE ADJUSTMENTS

Top Cover Removal

The top enclosure of the 160A must be removed to gain access to most of the test points and adjustments. Use the following procedure if your 160A is not equipped with an add-on module:

1. Remove the front cover of the unit.

2. Disconnect the power cord from the AC line and turn the POWER switch OFF.

3. Remove the six Philips head screws, one on each side, one on the top, and three on the back, holding the top enclosure in place (see figure 11-1). Lift the enclosure off carefully, and do not pull the cover away from the rest of the unit as there is a cooling fan mounted inside the top cover which is attached to the power supply board. Disconnect the fan cable from the connector on the power supply board..

4. Use the reverse procedure to replace the top enclosure.

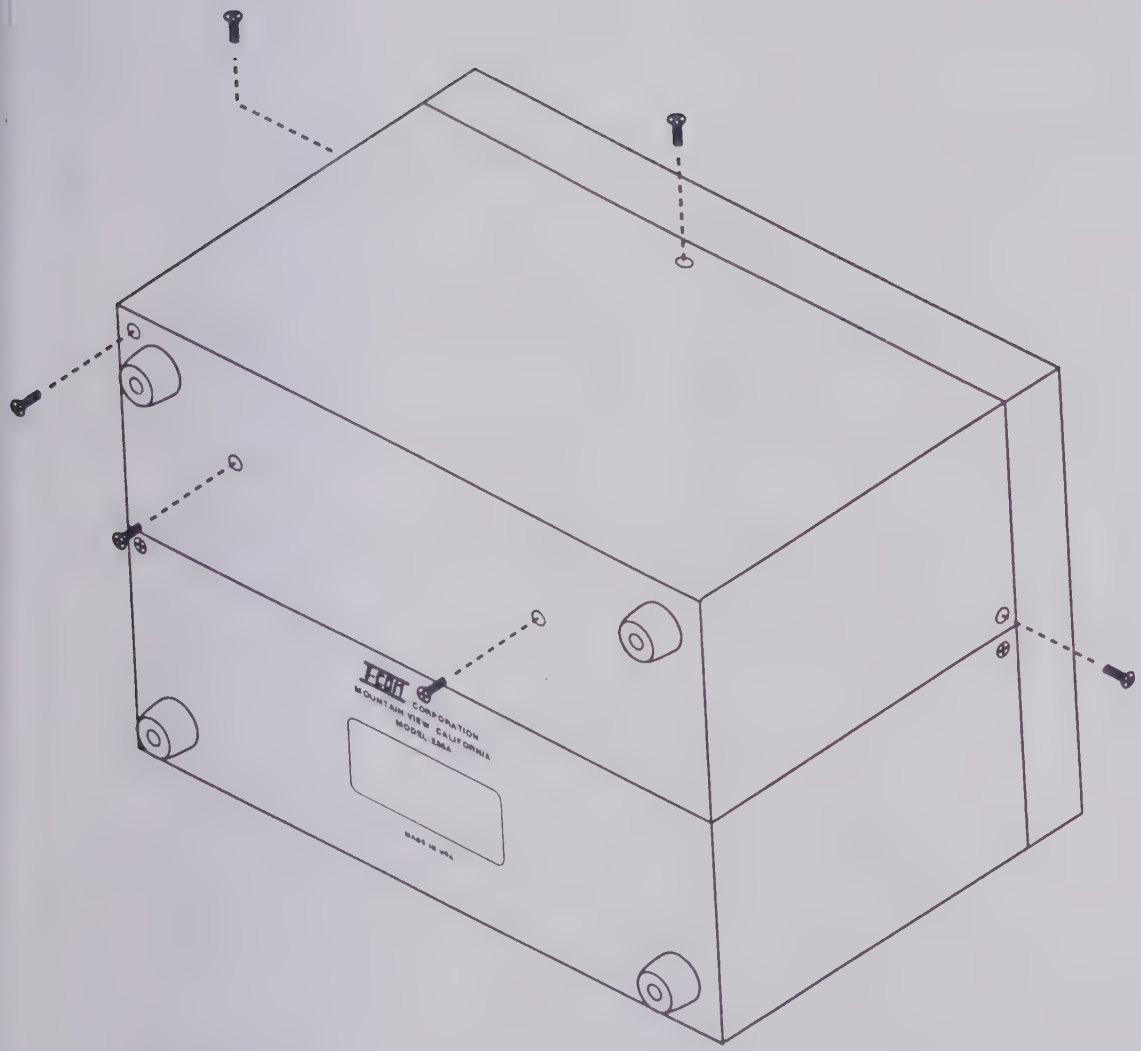


Figure 11-1 Top Cover Removal

6 CALIBRATION

6.1 Real Time Clock Frequency

1. Remove the front and top covers of the 160A.
2. Connect the frequency counter to TP5 on the MMC board (see figure 11-2) and chassis ground (Note: ground may be accessed at TP11 on the transmitter or receiver board).
3. Set position 5 of DIP switch S2 on the right side panel to ON (up).
4. Power up the 160A.
5. Adjust CT2 on the MMC board (see figure 11-2) for a reading of 64 +/- 0.0001 Hz on the frequency counter.
6. Power down the 160A and disconnect it from the AC line.
7. Disconnect the frequency counter leads from the 160A and replace the top cover.
8. Set position 5 of DIP switch S2 on the right side panel to OFF (down).
9. Power up the unit and set the real time clock and calendar as described in Chapter 3.

11.6.3 XMT Clock Frequency

1. Remove the front and top covers of the 160A.
2. Connect the frequency counter to TP10 on the XMT board (see figure 11-3) and chassis ground (TP11).
3. Power up the 160A.
4. Set the transmitter clock to INT on the VFDT (see Chapter 5).
5. Adjust CT2 on the XMT board (see figure 11-3) for a reading of 44.736 MHz +/- 300 Hz on the frequency counter.
6. Power down the 160A and disconnect it from the AC line.
7. Disconnect the frequency counter leads from the 160A and replace the top cover.

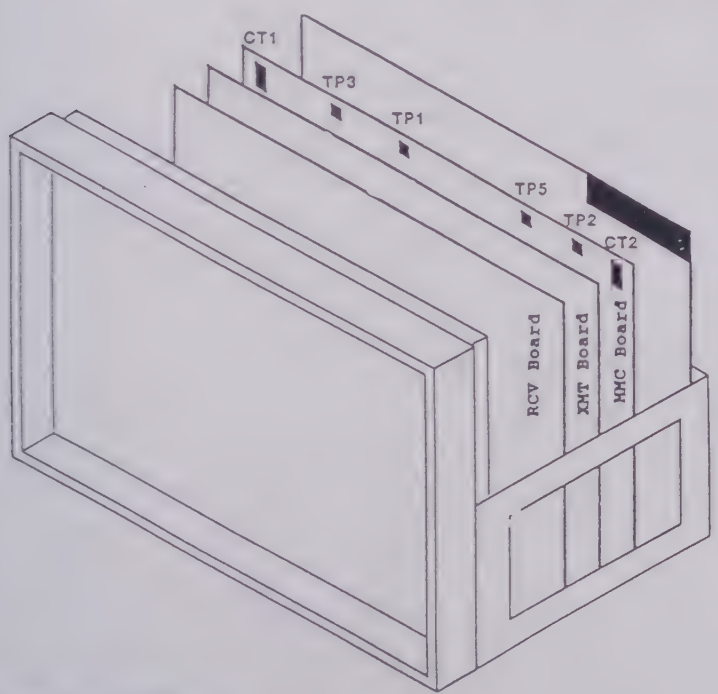


Figure 11-2 MMC Calibration Points

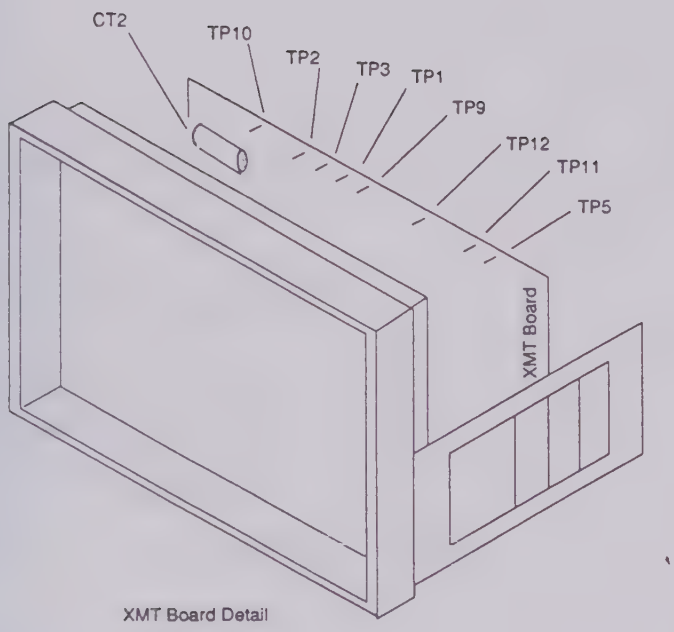


Figure 11-3 XMTR Calibration Points

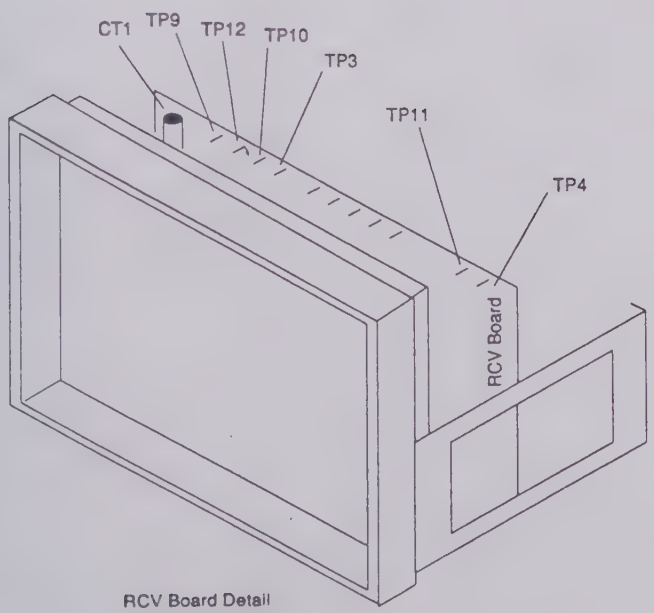


Figure 11-4 RCVR Calibration Points

11.6.4 RCV Clock Frequency

1. Remove the front and top covers of the 160A.

2. Patch the T3 output to the PCM INPUT.

3. Connect the scope probe to pin TP12 on the RCV board (see figure 11-4) and chassis ground (TP11).

4. Power up the 160A and ensure that there is an input to the INPUT PCM jack of the diagnostics receiver.

5. Adjust CT1 on the lower left side of the RCV board (see figure 11-4) for a signal with the least amount of ripple (i.e. the cleanest looking) on the oscilloscope.

6. Power down the 160A and disconnect it from the AC line.

7. Disconnect the frequency counter leads from the 160A and replace the top and bottom enclosures.

11.7 FINAL STEPS

Once the above calibration procedure has been completed verify proper reassembly of the top cover. Power on the 160A and confirm proper completion of the self test.

If appropriate, place a sticker near the serial number tag on the rear panel to indicate the date of calibration and the next calibration date. If any difficulties arise, please contact T-COM customer service at (415) 964-3415.

CHAPTER 12
ACCESSORIES AND REPLACEABLE PARTS

OPTION	DESCRIPTION
160A/01	**REMOTE CONTROL** (Allows operation via modem)
160A/02	**RS-232-C PRINTER PORT** (Provides printer/terminal or modem interface for downloading transmission impairment statistics)
160A/03	**C-BIT MESSAGE ANALYZER** (Displays various C-BIT parity data link messages)
160A/80A	**AUXILIARY DS3 SOURCES** (Add-on module that provides six independent time-delayed DS3 signals)

P/N	DESCRIPTION
Printer & Cables	
1470-002	Printer, Battery Operated Thermal 40/80 Column. Equipped with Serial & 8 bit Parallel Ports. 2.1 Lbs.
1479-002	Single roll of thermal paper for 1470-002
1479-003	Box of 5 rolls of thermal paper for 1470-002
1700-031	6 Ft Male/Male RS-232-C Cable
2700-032	6 Ft Male/Male RS-232-C Cable with null modem configuration
Soft Case	
2888-005	Canvas Carrying Case

P/N	DESCRIPTION
Extra Instruction Manuals	
IM160A01	160A Extra Instruction Manual
Miscellaneous Cables	
1690-002	4 Ft. Patchcord with bantam & 310 plugs
1690-003	8 Ft. Patchcord with bantam plugs
1690-006	4 Ft, 75 Ohm coaxial patchcord with standard (WECO 358) patch plug and male BNC plug
1690-007	4 Ft, 75 Ohm coaxial patchcord with standard (WECO 358) patch plugs
1690-008	2 Ft, 75 Ohm coaxial patchcord with standard (WECO 358) patch plug and male BNC plug
1690-011	8 Ft. Patchcord with nickel-plated bantam & 310 plugs
1690-012	8 Ft. Patchcord with nickel-plated bantam plugs
1690-017	6 Ft. 75 Ohm patchcord w/ WECO 358 to WECO 440
1690-018	6 Ft. 75 Ohm patchcord w/ WECO 440 to WECO 440
Miscellaneous Adapters	
1694-001	Bantam-to-310 adapter plug
1694-002	Standard (WECO 358) patch plug/BNC female adapter
1694-003	Mini (WECO 440)patch plug/BNC female adapter

IAPTER 13
ARRANTY

e T-COM 160A is warranted against fects in materials, software design and rkmanship for a period of one year from e date of shipment. Under this warranty, T-)M will repair at no charge any product fect or failure not resulting from misuse, gligence, accident or unauthorized repairs modifications.

ew software based features will be provided no charge for a period of six months after ıe original date of shipment if the new ɔftware requires no hardware changes to the nit and the features are provided free of harge in later issues of the product.

-COM does not assume any liability for onsequential damages. We reserve the right o make changes in design and construction f our products at any time without incurring ıny obligation to alter units previously sold.

This warranty is in lieu of any other warranty expressed or implied except as specifically modified in writing by an officer of T-COM.

Notes:

-With the exception of transportation costs, there is no charge for repair of instruments under warranty.

-Estimates of charges for non-warranty or other service work will always be supplied, if requested, before work begins.

ACCO® USA
WHEELING, ILLINOIS 60090
25973
MADE IN USA
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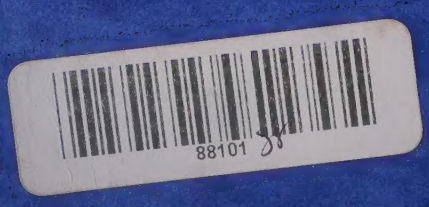
DK.BLUE/RL.BLEU/AZUL OBSCURO


88101